CHILD WELFARE

SIM WALLACE

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CHILD WELFARE

AND THE TEACHINGS OF CERTAIN DENTISTS SCHOOL MEDICAL OFFICERS, MEDICAL OFFICERS OF HEALTH AND OTHER MEDICAL MEN

BY

J. SIM WALLACE, D.Sc., M.D., L.D.S.
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LONDON HOSPITAL

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"AMONG influences tending in a serious degree to undermine the general health of the community, and so help to produce the conditions that foster tuberculosis, must be placed the decay of teeth among the working classes. . . . The Prudential Society, whose membership numbers 3,000,000, concluded from statements of their medical referees that the cause of quite half the illness found among the industrial classes was due to neglect of teeth; this statement was supported by the opinion of other friendly societies. A dental campaign is a matter of urgent national importance."—J. P. WATT, M.A., M.B., D.P.H., Medical Officer for the County of Aberdeen.

PREFACE AND INTRODUCTION

CONSIDERABLE attention is fortunately now being paid to child welfare, for it is felt that the great and unnecessary amount of disease and suffering which is afflicting the rising generation is an intolerable and disgraceful blot on the records of science and progress.

The waste in life and money caused by disease itself, and the energy and time absorbed in the treatment of the diseases directly and indirectly resulting from preventable causes, are admittedly appalling, and make it particularly urgent that at least some restraint should be put on those who are specially instrumental in causing disease by their ignorance, apathy, and authoritative position.

Much that is advocated in this little book might, could, and should have been done long years ago, if those in certain authoritative positions had been concerned in the welfare of children, and had observed the relation of the subjects they taught thereto.

The history of progress in science is often pitiable even when human welfare is not much at stake ; when child welfare is so directly concerned, obstructing the progress of science, either positively or negatively, is utterly deplorable. There are, however, hopeful signs.

Many humanely inclined are now interested, and some influential people with accredited positions are struggling against the old order of things which is so largely responsible for multitudinous troubles.

There are, no doubt, prejudices and hopes of preferment based on seeking favour from the junkers of science, and progress may be slow; but the old régime must be changed, and interests which do not harmonize with national welfare and humanity are not likely to be tolerated in the future when they are properly exposed.

I trust the following essays may give satisfactorily the views of what has been called the modern school with regard to oral hygiene, and what would appear to be becoming the views of the modern school of medical men interested in the prevention of disease in general.

As oral mal-hygiene and the diseases of the teeth are often the original source of other diseases, it would appear that our views should take precedence over those who want to begin at the wrong end. I am encouraged to say this because it is, or was before the war, explicitly admitted.

Thus, for example, in a criticism of my last little book on "Dental Diseases in Relation to Public Health," to which this is but a sequel, it was said that it could not "fail to bring home even to the doubter the great economical importance of dental diseases. The author shows that diseases of the teeth are quite easily preventable, and would be easily prevented if the medical profession would lend their aid, partly by realizing the nature of the pathological processes, and partly by advocating rational dietary. We are in entire accord with this statement. If the diseases of the teeth are prevented, the hundreds of thousands, perhaps millions, of pounds which are spent on their treatment would be saved. So, too, if the diseases of the teeth are prevented, the millions of pounds which are spent on the treatment of diseases resulting from diseased teeth would also be saved."

Such was the support which the *Lancet* and other important professional journals gave my views in 1914. Unfortunately the war broke out, and thoughts of the realization of preventive methods, which are infinitely better and cheaper than curative ones, fell to some considerable extent into abeyance. Now, however, if teachers and those whose duty it is to look after the nation's health are to remain at their posts, surely it is worth our while to see that they do their duty, and do it in the most efficacious and economical manner.

By way of introduction, it seems hardly necessary to do more than give two or three extracts from recent writings of medical men in very diverse magazines.

Under the heading of "A New Era in Medicine," "A Physician" in the *Statist* writes: "There is one disease above all others on which the public are urged to concentrate their attention, and that is, decay of the teeth. It affects almost every member of the community. It begins in childhood. It lowers the health of the child, and consequently it predisposes it to tubercle and disease generally. It is impossible to exaggerate the suffering and economic loss caused to the community by this apparently trivial but really terrible disease. It is estimated that at least 20 per cent. of all chronic disease in this country is due directly or indirectly to the state of the teeth. The cost to the country through the consequent inefficiency of its citizens amounts to an enormous sum every year."

In the *Medical Press* we read: "It has been proved up to the hilt that nine-tenths of dental disease is preventable. Of all peoples, the British have the worst teeth, and the shocking prevalence of dental disease among them is due to faulty dietetic customs. . . . It has been conclusively shown that dental caries is not due to defective resistance on the part of the teeth, but to faulty oral conditions operating upon the teeth from without. If the diet is so ordered as to leave the mouth clean—hygienic—after each meal, the teeth do not decay. Otherwise the most perfect teeth become carious." While in the *Parents' Review* Dr. James Wheatley, Medical Officer of Health for Shropshire, says: "We are in the fortunate position to-day of knowing how dental caries is caused and how it can be prevented. I have no hesitation in saying that the discovery of the essential cause of dental caries will rank as one of the great advances of modern medical science, and that so far as its effect upon the health of the people is concerned, it will probably be in the first place."

CHILD WELFARE

CHAPTER I

PROPHYLAXIS AT DIFFERENT AGES

> "Decay of the teeth is not a mere chance unfortunate disability of the day; it is the most urgent and gravest of all diseases of our time, a more serious national scourge than cancer or consumption . . . and is the main precursor and cause of unfitness and disease in general."
>
> F. TREWBY KING, C.M.G., M.B., B.Sc. (Public Health).

IT is generally admitted that the beneficent results of dental treatment are so great that the huge amounts of money spent annually for this purpose are amply justified. Nevertheless, the expenditure of money on the treatment of dental diseases ought soon to be almost wholly unnecessary, because we now know full well how dental diseases may be prevented. Moreover, treatment is not always perfectly satisfactory in itself. If the causes which render treatment necessary at any particular time are allowed to continue, re-treatment is almost inevitably required annually. Furthermore, treatment alone does not keep a mouth in a hygienic state, and the evil results of oral mal-hygiene may continue even after treatment unless preventive measures are initiated. With regard to the treatment of the teeth of adults, it is often found that nothing short of the wholesale extraction of teeth can be done to relieve the sufferers from certain dental and consequent diseases. So much so, indeed, is this the case that one of the first recommendations which a fashionable physician makes is to have all the teeth taken out of the mouth. Things have come to such a pass for want of early preventive customs that frequently this is the only satisfactory method of procedure. For these and many other reasons it is easy to see that treatment is, compared with prevention, relatively most unsatisfactory. Even among school children it has been found that the restoration of the teeth to anything like a physiological standard is, except among the wealthy, at present a hopeless dream. Where accurate statistics have been taken, children at the age of five entering school have been found to have more than six decayed teeth, and, as has been pointed out, "it is quite impossible by treatment afterwards to remedy this most disastrous start in life."* We may say that views such as these are now officially recognized. Thus Sir George Newman, in his Annual Report for 1912, as Chief Medical Officer of the Board of Education, says: "If permanent results are to be expected as the result of the appointment of school dentists, it should be clearly understood that the work must be undertaken on the lines of a well-organized plan, the first condition of which is that the scheme shall be laid on a *preventive* basis. In short, school dentistry must be conservative and constructive rather than palliative. It may not unnaturally seem to some authorities that the obvious course to take is to deal first with the children presenting the grossest amount of defect. On account, however, of the great volume of work to be done, such a policy will be found to be quite impracticable, and its cost would be prohibitive. Again, on such a plan no effective action is being taken to reduce the work of future years. The place of the children treated for advanced disease will be taken by others in whom the disease, though at first slight, has in turn become extensive. Further, if the time of the dentist be chiefly occupied with these cases of extensive disease, treatment can be given only to comparatively few children, very little being gained by applying partial treatment only. It is clear, therefore, that whilst palliative treatment of this kind appears to make, at first sight, a humanitarian claim upon us, it lacks constructive value, and, indeed, may easily prove ineffective and wasteful."

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* J. Wheatley, M.D., Health Report, 1912, County of Salop.

Ante-natal Considerations.—Theoretically we should begin prophylaxis at the beginning. Indeed, the earlier we begin, the more surely are satisfactory results likely to be attained. With regard to ante-natal considerations, however, we need not say much, because the importance of bringing physiologically perfect beings into existence has led Nature to guard against malign influences so effectually that we may say in general that babies are born into the world almost invariably satisfactory physically and potentially.

It may be, probably it is, true to say that the *raison d'être* of birth and death is to supply the physiologically fit while eliminating those who throughout the course of their lives have been more or less irreparably crippled by the "slings and arrows of outrageous fortune." Be this as it may, we at least do know that the temporary teeth—dependent for their development almost wholly on ante-natal conditions—emerge through the gums to all intents and purposes perfect and healthy in rather more than 98 per cent. of children, and this, be it noted, quite independent of the state of the teeth of the parents before, at, or after the birth of the child. There seems to be evidence that the normal potentialities to maintain the continual adjustment of internal relations to external relations—that is, to be physiologically fit for life—have a greater chance of excelling the mean of the two parents than of falling below it, because of what we may call the prepotency of the fittest.* Further, each generation takes its toll of the unfit, and, unfortunately, during recent generations more especially, the toll taken on account of defective teeth has been exceptionally large.

Notwithstanding this, however, all reasonable care should be invoked to maintain good stocks at least in a state of physical efficiency, and to shelter them from disease at this important period of their life, for we do not want even 2 per cent. to be started in life with an unsatisfactory chance either dentally or otherwise.

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* Transactions of the Royal Society of Medicine, vol. i., part 3, p. 120.

Infancy.—From birth to two and a half years a series of changes takes place in the anatomy and physiology of the infant which necessitates a corresponding set of conditions in its ideal environment. This is particularly noticeable with regard to the teeth, and to a certain extent the phases in the coming into being of the masticatory apparatus of an infant give a clue to the nature of the food most suitable for the child. The correct management of the infant during this period has been said by some to constitute the crux of the problem of how to prevent dental caries. And if we consider not only the benefits which are immediately derived from correct management during this period, but also the lasting effects which may be thereby derived, we may at least admit that this period is, or may be, of the very first importance. This being so, we must enter into the consideration of this subject at some length.

Before the infant has cut any temporary teeth, it is obvious that its diet ought to be, as its dentition and Nature intended it to be, mother's milk. Although it has been difficult to prove that the development of the teeth is notably or adversely affected by artificial substitutes for mother's milk, yet the consumption of artificial milk is liable to be unduly prolonged to the detriment of the teeth that have come into position ; or through mismanagement the artificial foods themselves may render the infant liable to infections and disease which have a deleterious effect on the enamel of certain teeth should it be in process of formation at the time of such illness. For this and other reasons care ought to be taken that the supply of mother's milk is adequate. No special deviation from ordinary healthy habits on the part of the mother need be made. On the part of the infant, however, it is necessary to see to it that it demands all that is necessary for its well-being. If the infant is kept suitably warm, it will suck energetically until its needs are satisfied. If, however, it is allowed to get unduly cold, it may not, it probably will not, exert itself sufficiently, and as the flow of milk tends to be or become proportional to the demands made by the infant, or occasionally by the infants, if the necessary vigour on the part of the infant fails, so, too, will the amount of milk secreted by the mother fail.* For these and other reasons it frequently is desirable that the infant should derive a certain amount of heat from the mother during sleep.

The formation of the teeth is not the only thing which must be considered during this period; the arrangement of the teeth is affected, often for life, by influences which may be imposed upon the child at this early period of life. The mandible at birth is of no great size, and it is not rigidly related in position to the maxillæ. It is necessary, however, that the teeth as they erupt should become very definitely and accurately adjusted, so that each tooth in the mandible as it erupts shall take up its correct position with regard to the antagonizing teeth. For if the teeth do not come into perfect occlusion in infancy, it is extremely unlikely that their correct positions will ever be attained throughout life. The first factor which tends to make the mandible take up its proper position with regard to the maxillæ is the tongue. The second is the continuous efforts which the infant makes to antagonize the primitive alveolar ridges, and later the incisor teeth which pierce the firm gum over this ridge. A certain latitude is, as it were, allowed the infant, but, provided circumstances are favourable, it soon learns from its instinct to gnaw what position is exactly the most perfectly adapted for gnawing. The incisor teeth, and consequently the jaw, are, as it were, habitually set for this position, and the growth of the bone is stimulated in such a way that the ideal relations of the upper and lower teeth are, or rather may be, practically invariably secured. Thus, then, it is of special importance to note that conditions which would interfere with the tongue acting as a common denominator for the relative positions of the upper and lower jaws should not be allowed to develop, nor should the instinct of the child to gnaw be interfered with. For these reasons at this age: (1) Mouth-breathing must not be induced by allowing the infant to breathe unduly cold and damp air, for this, directly and indirectly, by depressing vitality and inducing infection, tends to cause chronic or acute inflammation of the naso-pharynx, and thus to impede or block the breath-way through the nose. Should mouth-breathing supervene, the effect which the tongue has in correlating the position of the upper and lower jaws is lost and the influence of the tongue in broadening the upper jaw more especially is more or less in abeyance. The practical point, which is so frequently flouted, is to recognize the necessity of protecting the infant from climatic influences which will deleteriously affect the naso-pharynx. That is to say, in cold and damp weather artificial methods should be invoked to dry and warm reasonably the atmosphere which the infant has to breathe. Nothing worse can be done than to force the infant to sleep overnight in an unwarmed room with the windows open if the atmosphere is cold and damp, as it pretty generally is in this country from November to March. (2) Gnawing must not be prevented by withholding suitable articles, or, later, foods which may be gnawed and sucked. (3) Cleanliness of articles or foods must be secured, otherwise unhygienic states of the mouth and alimentary canal are liable to be induced and the nutrition of the infant interfered with. Should such nutrition be interfered with, the infant tends to lose that plumpness which is characteristic of health, the tongue shares in the general emaciation, and so correspondingly is one of the normal stimuli of development of the jaws interfered with. This all indicates that, should the mother have adopted or been induced to adopt a method of rearing her infant which results in a failure of the natural milk supply, the greatest possible care must be taken to secure thorough cleanliness in the feeding of the infant. This need not be insisted upon here because, quite apart from dental considerations, this is already recognized by the medical profession. We have now to refer to the natural transition from the purely milk diet to the varied and solid diet which is indicated by the dentition of a child of two and a half years. First of all, however, we must rid our minds of a theory which has dominated the minds of children's specialists in all civilized countries for the last few decades. Briefly their pernicious theory is as follows :

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* "Causes of the Failure of Women to nurse their Infants at the Breast" (Hector Charles Cameron, M.D., *Lancet*, 1913).

The first thing that a child should be given is milk, and this should be continued till about the ninth month ; thereafter, it is contended, a gradual transition should be made from the milk diet to the solid and varied diet which the child, as it grows older, should be given. The change is effected by gradually introducing more and more solid food into the milk, as, for example, flour, arrowroot, and bread. This is continued for a time, and then porridge and milk and milk puddings are given. Theoretically and practically, however, this is a most unnatural method of making the transference from a milk diet to the varied and solid diet of childhood. First of all, it should be noted that theoretically milk should never be presented to infants ; it is the mother's breast which should be presented to them. From this, of course, they naturally suck liquid milk ; when the time comes for supplementing this with other articles of diet, theoretically, a solid piece of food which the infant can partly take into its mouth should be given to the child. Of course such food must be of such a nature that the child can gnaw it and suck nutriment from it, or by insalivating it can reduce it to a more or less liquid state. If a child has not been cheated into gulping down solid food by making it as like milk as possible, solid food of a physical consistency not resembling milk is arrested in the mouth, and retained there until by the action of the teeth or gums and tongue it has been reduced to a semi-liquid state. It is not my intention to repeat here the arguments or details with regard to this method of effecting the change from the liquid milk diet to the varied diet of childhood. Suffice it to say that bread and crust with butter, or preferably toasted bread and butter, may be given as the first solid article of diet, say about the age of nine months, provided it is *not* soaked in milk. The further introduction of solid foods into the child's dietary, such as boiled fish, meat, etc., need not be referred to here, for unless such foods are deliberately finely ground, pounded, or minced, and unless the physiological instincts of the infant have been perverted by compelling it to subsist for a long time on pappy foods, it naturally takes to solid foods, sucks them, insalivates them, and incorporates them with mucus, so that they arrive in the stomach in exactly that state which is best calculated to promote their digestion. The experiments of Dr. F. D. Boyd seem to prove most conclusively that the presenting of food in a sloppy form interfered in a most marked way with normal digestion.*

The times at which food is given to infants require supervision. It has been shown that an infant does not thrive so well with the customary short intervals between feeds as it does when longer intervals are made between the feeds. Still more as the infant grows older, while the solid food is increased and the milk decreased in amount and in concentration, so should the intervals between the meals increase. When first solid food is introduced into the child's dietary it may be given as part of a meal immediately preceding the milk, which, of course, at this time continues to be the chief nutriment of the child. For a few weeks, then, say half a slice of bread and butter or toasted bread and butter should supplement the milk diet. Later this may be given twice and three times daily.

The next sort of food to be introduced into the infant's dietary and to which we may direct attention is uncooked food. When mother's milk is given, this need not be introduced till after the change to solid food such as we have indicated has been effected. But when the infant is brought up on sterilized milk or other similar cooked food, the uncooked food should be introduced at a much earlier date. Uncooked milk is unsuitable on account of its liability to be germ-polluted. Uncooked meat does not generally recommend itself, although in exceptional cases raw-meat juice may be given with advantage. The uncooked food which has been found most suitable—quite independent of dental considerations—is fruit juice. Fruit juice, then, should be introduced into the dietary of the infant a long time before the solid food is introduced in cases of bottle-fed children, and before or after the solid food is commenced in the case of breast-fed infants. The pulp of grapes or liths of oranges to suck at one meal daily will suffice at first. Sugar cane, when it can be got fresh, forms an excellent form of raw food for the supply of the fresh vegetable juices which are desirable for oral hygiene and for the infant. The infant gnaws and sucks just as it sucks the mother's breast, and the two lower incisors which cut the gum at an early age seem specially adapted for the piercing of such a food, so as to facilitate the extraction of the juice. There are other reasons for the introduction of uncooked foods into the dietary than considerations with regard to the teeth, and it seems probable, in view of the investigations into the nature and uses of vitamines, that uncooked foods will come to have a recognized place in the dietary both of children and adults in the future. It should be noted that the imposing of environmental conditions on the individual differing from those which obtained during the evolution of the species may be attended with serious risks which are frequently undreamt of, and it is gratifying to find that similar recommendations to our own have recently been made with regard to diet and nutrition generally. It is probably accidental as far as digestion of starch is concerned that the ptyalin should appear in the saliva about this time ; it is not accidental with regard to the hygiene of the mouth. The appearance of ptyalin in the saliva should synchronize with the coming into position of the teeth, because it is primarily and principally for the sake of oral hygiene that the ptyalin exists in saliva.

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* *Dental Record*, June, 1913.

After these changes have been made in the infant's diet—say some time between the tenth and twelfth month—some lightly cooked animal food may be introduced into the dietary once daily—*e.g.*, fish, meat, chicken. When this is done, a considerable reduction in the concentration of milk diet at the particular meal should be made, and, indeed, the milk at such a meal may soon be wholly replaced by water. In making the above changes, or in making variations from these changes, the following points should be considered :

(1) A knowledge of the natural foodstuffs which have in past ages been habitually given to children.

(2) Knowledge of the artificial foods which are generally used, together with a recognition of their defects, physical and chemical.

(3) A recognition of the likes and dislikes of the child with regard to natural foods.

(4) To introduce only one new foodstuff into the dietary of the child at once, and to make sure that this agrees with the child before making further alteration.

(5) To increase the intervals between meals accord- to the length of time required for digestion in the

stomach ; this attention is to be regulated by previous knowledge, the appetite of the child, and the needs of civilization—*i.e.*, regularity of meals and ultimately three meals daily.

It may indicate a little more clearly what the changes from the milk diet become as time goes on, and what intervals are usually most satisfactory to give the following table of a daily dietary suitable for an infant of about seventeen months :

6 a.m. : Milk and water (equal parts) with a little sugar of milk added.

8 to 8.30 a.m. : Boiled fish or egg, bread with crust and butter or toasted bread and butter ; milk and water.

12.30 p.m. : Soup with toast, fish or chicken, or a little mutton, potatoes, bread with crust or toasted bread and milk pudding ; water or milk and water.

4.30 to 5 p.m. : Bread and butter or toast and dripping, the pulp of three or four grapes or orange liths to suck only ; water.

On going to bed : Milk and water.

The child has now got sixteen teeth, and until the second temporary molars are cut—that is to say, between two and two and a half years—the hygiene of the mouth is suitably allowed for in such dietary, for until the second temporary molars are in position there are, as a rule, no crevices or spaces existing of a kind such as would be specially liable to retain carbohydrate foods. When, however, the second temporary molar comes into position the liability for food to lodge in the crevices of this tooth or between the temporary molars is considerably increased. Consequently between the age of two and two and a half years food of a still more detergent nature should be introduced into the dietary, so that each meal will terminate in such a way as to leave the mouth physiologically clean. To reduce this conception to a practical form fresh fruit should be introduced into the dietary in such a way as to terminate each meal, and the milk, which before the end of the second year may be given before going to bed, should be stopped. The type of meal, then, which is required for oral hygiene and the prevention of dental diseases should be fully developed at the end of the second, or at latest at the end of two and a half years—that is to say, the bulk of the food should require and stimulate thorough mastication. Milk should have by this time become a more or less negligible part of the meals, and food of a detergent nature should terminate the meals. Thus, then, we may say that the child's diet at and after two and a half years should be such as the following:

Breakfast: Fish or, later, bacon; toast and butter, water or weak tea or coffee, a slice of melon.

Luncheon: Meat or poultry, potatoes, vegetables, pulled bread, well-baked milk pudding, fresh fruit, water.

Supper: Rusks, toast or bread-rolls and butter, fish, water or milk and water, fresh fruit.

Two and a Half to Six Years.—We now pass to the consideration of prophylaxis in children between the ages of two and a half and six years. The diet having been already developed and due recognition having been taken of the masticating apparatus, no essential change is at all necessary. In all probability the child will have formed such habits of mastication and insalivation as will make it tend to dislike and reject food of a pappy nature. The child whose mouth has thus been habitually kept physiologically clean will resent most foods of a sticky nature which tend to cling about its teeth. If not, in order to stimulate the cheeks, tongue, and saliva and mucus in the cleansing of the mouth, coarser foods may be introduced occasionally, such as nuts, which, until they are thoroughly masticated and completely removed from the mouth, tend to stimulate the mechanical self-cleansing processes to act thoroughly.

Here a word may be said with regard to the action of the tongue in the removal of food particles from the teeth. It is recognized that, except when pits exist on the lingual surfaces of the teeth (and these do not exist in the temporary set), rarely do we find caries commencing on such surfaces. This in itself indicates that the action of the tongue in general is an important factor in the self-cleansing of the teeth. But even more than we might at first be inclined to believe, the tongue exercises an effect in cleansing between the teeth more important than a tooth-brush. By chance one day I observed the action of the tongue in cleansing a slight space about 1 mm. broad between an upper canine and a premolar. I was surprised to observe how it seemed to adapt itself for this purpose. It, as it were, squeezed a little part of itself between the teeth to brush out food particles. Moreover, the tongue being solid rather than of a bristly nature, the saliva was no doubt also pushed between the teeth, thus tending to dislodge food and to cause the saliva to permeate any food which might still remain. Of course the tongue, lips, and cheeks act in other ways for the removal of food except when through habitual lack of normal stimulation the mouth has become callous to lodging foods. But further reference to these self-cleansing processes need not be made here.

The period under consideration (*i.e.*, from two and a half to six years) derives its special importance from the fact that the children are not at school and are wholly under the home influence. At one time, now some decades ago, instinct, necessity, and traditional knowledge helped to guide mothers at this age, but gradually the precepts of medical men with regard to diet, either indirectly through books or directly from word of mouth, have come more and more to supplant traditional knowledge and custom. Notwithstanding, or rather on account of this, dental and concomitant diseases in children have been increasing with marked rapidity. We can hardly wonder at this, because the physiology of oral hygiene was unknown, and medical men were not taught the subject, and the principle that meals should be of such a nature or so arranged as to leave the mouth and teeth physiologically clean was never inculcated. Indeed, when we consider what was actually universally recommended for young children as regards diet, we might almost feel inclined to think that the guiding principle had been the recommendation of foods which would be sure to leave the mouth physiologically dirty, and often when resulting ills supervened children have actually been forced to take medicated or malted syrups three times a day after food! Here, then, we are faced with a very serious difficulty. How have the errors of the immediate past to be rectified? Who has to bring home the simple truths of hygienic living, more especially with regard to diet, to those who are bringing up children? Are we sure that this can here and now be entrusted to the medical men who learned the principles of dietetics as they were taught ten, twenty, or thirty years ago? Are we sure that as regards the diseases of the teeth, or indeed other diseases, the children of those they teach will be brought up with less dental disease than their own children actually have? It has been pointed out that "amongst the children of our elementary schools the most neglected have the least caries." This must mean that the extra care given by conscientious parents to their children has directly increased the amount of caries.* The evil, then, obviously arises to some extent from bad counsel and a misdirected care. Who, then, have to be selected to re-educate the mothers in the feeding of their children? Has the teaching of dietetics to be transferred from medical men to dentists, or have medical men to continue teaching, or, again, have school nurses to be taught the principles of dietetics in order to teach the parents of the poor? My own opinion is that the teaching of dietetics should not be undertaken by the dentist or any other specialist at the present time, nor should it be transferred to the school nurse, except in those counties where the Medical Officer of Health has himself become master of the requisite knowledge. The medical profession and health visitors might do much good, yet if all those who would be required for such teaching purposes, but who do not know the principles of dietetics referred to above, were set this task, probably at the present time more harm than good would result. There is only one proper solution to the problem: primarily we must direct our immediate efforts to teaching the teachers of physiology the elements of the physiology of oral hygiene, and try to bring home to them the stupendous havoc in the teeth and other parts which erroneous teaching or the absence of teaching has given rise to in the past. Then nurses, health visitors, medical men, and dentists will become able to teach harmoniously, and then the fundamental principles of physiology, although consciously unknown to the multitude, will establish customs, habits, and current knowledge which will wipe out one of the darkest and most widespread stains of our civilization.

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* Fifth Annual Report of the School Medical Officer, County of Salop.

It is a common tenet amongst scientists that science must be pursued for its own sake. Whether this is maintained on account of the sterility of by far the greatest part of their work need not detain us: what we must note is that such an attitude gives rise to delay in the benefits which should be derived from scientific investigation.

If, however, there is too much delay, as indeed already there has been (for the great professors and lecturers in physiology may resent having their attention directed by us to the fact that there is such a thing as the physiology of oral hygiene, and that it is a branch of their own subject of the greatest importance), then Medical Officers of Health and School Medical Officers must still further push forward the campaign of instruction themselves, for, as Dr. James Wheatley says, having special regard for his own county, "the need of a campaign to prevent the conditions above described is most urgent. Each year of delay means another 1,200 children in the county who will have at the age of five ten or more decayed teeth, and about 1,800 children who will have five to ten decayed teeth." And, further, he says what is *most important:* "It is quite impossible by treatment afterwards to remedy this most disastrous start in life."

The next period which we have to consider—namely, from six to fourteen years—derives a certain special interest not only from the fact that during this period the temporary teeth are shed and the permanent ones take their places, but also because during this period the child comes more or less under the care and influence of the teacher and the school. The school should both by precept and example inculcate such elementary truths as will help children physically, morally, and mentally. If good habits with regard to oral hygiene are not established, discipline must do what it can. Thus, then, to give an apposite example, if children through misdirected care before entering school have a pathological craving for sweets at the wrong time—*i.e.*, at the end of or between meals, or before going to bed—the school may be able by physiological means to restore physiological instincts, or, should it be necessary to enforce the required restraint, discipline such as would put an end to these practices must be instituted. Physiological means of correcting bad habits in eating can hardly be given except at boarding schools, but this is a special reason why such schools should use these means, for it is such schools as these which have an influence beyond their own gates. It is during this period also that the child may be subjected to the influences of the school dental clinic. At this time, notwithstanding the change from the temporary to the permanent dentition, there is no necessity or reason for modifying the principles and methods of prophylaxis; there is, however, in some ways increased facility and opportunity for teaching the principles of prevention. Where a school clinic exists, it may be made a centre for spreading useful knowledge to the children and the parents at the particular time when the necessity for knowledge with regard to the prevention of dental disease is most acutely felt, and at a time when the parents may be most willing to recognize the faults they have made in the past and determine to make the necessary changes for the avoidance of further operative work upon their children. Unfortunately it sometimes happens that the dental surgeon appointed has too much operative work to do, and the use for prophylactic purposes which the school clinic might have may be more or less completely lost. Even where the chief medical authority has been anxious for preventive measures to be taken, the appointment of a dentist unfamiliar with modern preventive methods has hindered rather than facilitated the ideal aim of prevention.

Here, too, it may be noted that the appointment of a school dentist through the initiative of the Medical Officer of Health may be a means of shirking the duty of the prevention of dental disease rather than a means of furthering it. Essentially the function of the dental surgeon is the treatment of the diseased conditions of the teeth. It is not the teaching of physiological principles for hygienic living ; rather is this the duty of the Medical Officer of Health or the School Medical Officer, and the appointment of a dental surgeon *does not in any way absolve them from this duty.*

With regard to prophylaxis during adolescence, maturity, and old age little need be said. If the physiological principles which we have indicated as necessary for the right bringing up of children are recognized, their beneficent influence will extend from them to their parents. Just as in the past adults, mothers more especially, partook of similar meals to those of their children and with similar results—*i.e.*, destruction of the teeth—so, too, in the future will they do likewise—*i.e.*, partake of meals of a physiologically correct kind which will tend to preserve their teeth in later life.

Artificial Prophylactic Measures.—We have briefly reviewed the physiological or natural means of preventing the diseases of the teeth, and now must say a few words on artificial means. Much has been written on this subject and much that was erroneous has been taught. When, however, the physiological means are known, artificial means that aid these physiological means can readily be established. Because, moreover, we call certain means natural and physiological, that does not mean to imply that artificial means are antagonistic. In the past, when antiseptic mouth-washes and tooth-powders loomed largely in prophylaxis, no doubt the artificial methods were neither natural nor physiological, but these as a means of preventing caries and erosion, or even pyorrhœa, do not now figure prominently in artificial methods of prophylaxis.

Civilization, however, often enforces very strongly certain more or less artificial procedures which in remote epochs may not have been customary in the species. But even here we often see the rudiments of modern artificial hygienic precautions which among civilized beings are strict and regular daily customs.

It may not be known whether our simian ancestors chewed some fragrant herb without nutriment; nevertheless, for our present purpose we may at least assume that this was occasionally done. Such fibrous herb may have its evolution investigated some day, and we may yet know the story of the evolution of the tooth-brush. The point of importance, however, is to recognize that the tooth-brush when used properly is an aid to oral hygiene, even although its mal-use frequently causes erosion of the teeth, and even although statistical evidence would sometimes seem to indicate that it did no good.*

The beneficent effect of the tooth-brush may be enhanced by using it with an aromatic and acid mouth-wash, for such a mouth-wash stimulates the chemico-physiological self-cleansing processes. There can hardly be any question with regard to whether aromatic mouth-washes do good or not; with regard, however, to the value of a certain acidity in the mouth-wash some difference of opinion still exists. For certain reasons a decade or more ago I enjoined caution in the use of alkaline mouth-washes, and later, basing my recommendations on the effect of acid in stimulating a flow of alkaline saliva which I called the natural mouth-wash, I recommended a slightly acid mouth-wash. I do not know, however, that statistical evidence has as yet been brought forward to prove the beneficent effect of such mouth-washes, although I still claim that they are beneficent. But I do know that certain alkaline mouth-washes have been recommended and widely used, and that they have been recommended by those who have no commercial interest in their sale because of the satisfactory results which appear to have been derived from their use. I will admit that under a proper dietetic régime I have heard of satisfactory results with alkaline washes, and there does not seem to be any necessary reason why there should not be. The work of Professor Gies and his collaborators would appear to indicate that the mucous coverings on the teeth when treated with basic alkaline substances may facilitate the removal of food particles; thus Drs. Gies and Lothrop say: "Mucin occurs in saliva, apparently also on dental surfaces, primarily as acid-salts in concentrated colloidal solution. When viscid mucinous coatings are treated with basic material, such as carbonate of an alkali, or an earthy element, the mucin mass becomes superficially more smeary and slippery by reason of the production of more soluble mucin-salts at the surface. Complete mechanical removal of a mucin plaque from a tooth is facilitated by the addition of a basic material that renders the mucin superficially more viscous, but the slippery surface thus produced may make the application of considerable friction necessary for the detachment of the plaque."*

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* Such statistical evidence as indicates that when the tooth-brush is used the teeth are no better than when it is not used resulted from comparing the teeth of school children of a different class, no doubt the class which received the most misguided care with regard to diet being compared with the class which did not.

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* *Journal of the Allied Societies*, December, 1910, p. 283.

Thus, then, we are led to conclude that the use of alkaline mouth-washes may possibly sometimes be useful. Inasmuch, however, as the surfaces of mucous plaques are smeary or slippery, due to the saliva, the simplest adjunct to the tooth-brush in the regular brushing of the teeth *before* breakfast is water without acid, for if it be granted that the mucous covering on the teeth facilitates the passage of the food through and out of the mouth, more especially when its surface is slippery, then the complete disintegration by acid of this mucus and its more or less complete removal *before* a meal might favour rather than prevent the lodgment of foods of a carbohydrate nature taken immediately thereafter. That the mouth-wash should be aromatic and acid *after* meals, however, conforms best with the teachings of the physiology of oral hygiene. In fact, the use of the tooth-brush, together with diluted acid and aromatic washes, duplicates in a way what we have indicated as the correct physiological termination of a meal from the point of view of oral hygiene.

In considering artificial prophylaxis reference has not been made to different age-periods, for such artificial measures should begin as early as conveniently may be, and should continue throughout life.

Prophylactic measures which the individual may undertake should be supplemented by periodical visits to the dentist, for at present and for many years to come there will continue to be a very large, though decreasing, number in which the errors of infancy and childhood have left such an impression that absolute reliance on prophylaxis would hardly be wise. Particularly should those visits be made regularly until at least the patient has been repeatedly told by his dentist annually that there is no pathological or unhygienic condition of the mouth for him to ameliorate.

In conclusion it should perhaps be stated that reliance on artificial methods, even including periodical visits to the dentist, should never be allowed in any way to interfere with or to countenance any lapse from the natural and physiological means of preventing dental, concomitant, and consequent diseases. The tooth-brush and mouth-washes will do extremely little to prevent the irregularities of the teeth, and yet such irregularities may predispose to dental caries, unhygienic states of the mouth, and later to pyorrhœa. And until physiological or hygienic principles of dietetics are understood, taught, insisted on, and carried out in civilized communities the diseases of the teeth will, in spite of all artificial methods of prevention, continue to be a blot and disgrace which we can only contemplate with feelings of shame. Fortunately, however, we know that the influences which led to the increase of dental and concomitant and consequent disease are being more or less completely exposed, and our triumph over them is already assured.

CHAPTER II

THE PRINCIPLES OF DIETETICS

"There are few questions of greater moment calling for the attention of the health and education authorities of this country than this one of diet, both in relation to the teeth and to the general nutrition of the child."—SIR GEO. NEWMAN, K.C.B., Chief Medical Officer of the Ministry of Health.

SOME fifteen years ago the study of the ætiology of dental caries led me to conclude that there must be something radically wrong with dietetic habits which were current in civilized communities. Further, it became impressed upon me that the dietetic precepts emanating from the highest quarters were on the whole productive of harm rather than good, for it was by no means apparent that dental caries and other diseases resulting from bad dietetic habits were less common among the children of professors of physiology, or among the children of medical men generally, than among the children of the relatively ignorant poor. In fact, in time it became evident that the teeth of the children of poor peasants, and even of those living in slums, were rather less ravaged by caries than were the teeth of those who were supposed to be enlightened in the science of dietetics. Naturally, I tried to inform myself on the subject. Among other things, I bought a book on "Food and the Principles of Dietetics," and therein found quite a mass of information on the chemistry of foods and certain physiological details associated therewith, but I found remarkably little about the principles of dietetics. Indeed, if I remember rightly, the author of this misnamed manual seemed quite to approve of the dictum that one man's meat was another man's poison, which, rather than being a principle of dietetics, seemed to me to imply a negation of all principles. I have not recently tried to gain knowledge from books of this nature, being convinced that masses of scientific detail which are not directed by philosophical thinking are on the whole productive of more harm than good. It is not, therefore, my intention to treat the subject as it is treated in books on dietetics, but rather to indicate that the principles of dietetics branch naturally from the tree of knowledge and bear fruit which is, or may become, of great value.

I shall endeavour to state some principles of dietetics and add but a few words to each of them, as it is not possible in the short time at my disposal to do more. Nor, until the acumen of your criticisms makes me wiser, would it be advisable to attempt to do more.

The first principle I would refer to is that *the kind of food for which man is adapted is the same in all essentials as that on which he has subsisted for countless generations.* This principle is lacking in direct practical utility—firstly, because we may not know exactly the kind of food on which primitive man and his ancestors did subsist; secondly, because we are not all agreed with regard to what are the essential elements of food; and, thirdly, because man has introduced methods of preparation of foods which, though in some cases they may destroy or impair certain essential qualities, so far improve others that a reversion to primitive foods would be a retrograde step. The value of constantly bearing in mind this important principle, however, will be seen from some of the principles which follow, for without this one a certain guide for the search for others would be lacking. Here let me say a word with regard to the essential qualities of food. Generally, it is believed that the essential elements of food are that they should be capable of being transformed into nourishment for tissue building and repair, or for the production in the body of heat and energy. This may be considered the basic assumption of most physiologists. Recently it has been suggested that vitamines should be regarded as essential elements in food, though how they benefit tissue building or the production of energy has not been worked out. Similarly, bacteria and bulk, or ballast, have been regarded as essential, though how far they are so has been more or less obscured by an almost exclusive study of nutritive qualities. All that I would say here is that such a conception of what are the essential elements of food shows a great lack of knowledge of certain points that have been evident to dentists for many years. It has been evident to all of us who regarded dental caries as a diet, or rather a dirt, disease that an essential element in diet is generally lacking in the diet of the civilized, though it was present in the diet of primitive man. Continued study of this point showed that this essential element had nothing whatever to do with nutrition. We shall consider this subject later ; in the meantime it is sufficient to note that food should not be unhygienic ; in other words, that food should not induce stagnation or fermentation and putrefactive processes which the normal physiological reactions of the alimentary canal are unable to control.

The next principle to which attention may be briefly directed is that *the anatomy of the organs of digestion indicates the type of food which is most generally suitable for the animal under consideration.* This principle has long been recognized by those who have concerned themselves with palæontological zoology. It has, however, been most completely disregarded by medical experts, who have occupied themselves with framing the pap dietary for young children which still too generally holds sway. It is now many years since the dental profession recognized that the complete temporary dentition indicated that the most suitable diet for a child was not pap, but should be of such a nature that the teeth and jaws would require to be used. Moreover, we recognized still further that the coming into position of the milk teeth indicated how the transition from the purely milk diet to the solid and varied diet suitable for children with a complete dentition should be brought about. At one time there may have been a certain amount of indefiniteness with regard to what might be considered a suitable diet for a child with a complete set of teeth. For many years a large number of the dental profession at least claimed that the food should be hard, so that the teeth might have sufficient use. Further study, however, made it evident that the use of the word "hard" was not quite *à propos*. Bones, chocolate, toffee, etc., can quite properly be designated hard, but such foods could not, in our opinion, be considered generally suitable for children. It happens that there is a peculiarity in the dentition of man, and, as far as we can see, in those of his ancestors, which makes it evident that the masticatory organs of man are not specially suited for such hard foods. A carnivorous animal, whose teeth are specially adapted for crushing bone or tearing flesh from it, does not possess the power of lateral motion of the jaws such as is more especially characteristic among the herbivora. The temporo-mandibular articulation indicates this, as does also the occlusion of the teeth. Even our nearest relations, the anthropoids, have not the power of grinding food such as man has. The canine tooth in man is not raised above its fellows so as to prevent lateral motion during mastication, and this anatomical peculiarity appears to have existed coevally with man. Here we may say parenthetically that we must not lay too much stress on the type of food which present-day anthropoids eat. They may have been driven to live on trees by their more intelligent cousins the progenitors of man, and their food habits and dentition specialized accordingly. The food, then, which will stimulate the use of the teeth and be most thoroughly disintegrated by lateral motion during mastication is fibrous rather than hard. Fish and meat, vegetables, and many fruits (all of which we dentists are fairly well agreed are desirable from the point of view of dental hygiene) may be called fibrous, but we should be speaking loosely to call them hard. Furthermore, it is undesirable to say that hard food is suitable for children, because it is only fibrous food which can be relied on to clean the teeth, for the juices and particles incorporated in the fibrillar meshwork are expressed during mastication, and the more fibrous part which is left last in the mouth is converted into a kind of mop which helps materially to keep the teeth and gums clean. An important confirmation of this view has recently been made by Mr. Brook Nicholls* in a communication dealing with the state of the teeth of the children living in the Bass Strait. Selecting the most general characteristic of a food as a basis for generalization is useful, but it should be noted here that the separation or isolation in thought of different constituents in the food and considering them separately is liable to give rise to erroneous teaching. We must, for example, remember that "most vegetable foods, especially fruits, very generally associate cellulose, sugars, acids, and acrid principles, and it is scarcely right to consider the effects of any one of them when dissociated from the others."

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* Brook Nicholls, *Australian Journal of Dentistry*, March, 1914.

A consideration of the above leads us naturally to the third principle which we have to note—namely, that the *physiology of the organs of digestion indicates to some extent the type of food suitable for man.* To begin with, however, what is the outstanding physiological process for which the first part of the alimentary canal is adapted ? The incisor teeth incise or cut off portions of food, and the molars crush, tear, or physically disintegrate it, while at the same time the saliva and mucus are secreted. The muscles of mastication concerned with the closing of the mouth are physiologically adapted for the exercise of enormous pressure in order to disintegrate the food, while the muscles which open the mouth are relatively weak. If the food were intended to be swallowed without undergoing physical disintegration in the mouth there would be no need for the large muscles and elaborate physiological co-ordination which at present (necessarily) exist. As far as the digestion of food is concerned, the obvious inference is that, with regard to the mouth and teeth, the physical disintegration of the food is practically its one and only function, notwithstanding the fact that we may possess books written on "The Work of the Digestive Glands," in which the salivary glands are largely referred to. Do not let us be befooled into believing that the physiological *raison d'être* of the salivary glands is solely or even primarily for the sake of digesting food. The salivary glands exist and function for the purpose of facilitating the movements of mouth and food, for facilitating disintegration, for facilitating deglutition, and for helping to clean it out of the mouth as rapidly as possible after the disintegration of the food is sufficiently advanced. We have heard a great deal about the digestion of starch by ptyalin, and although the amount is very trivial it was well dinned into us that the function of the ptyalin was to digest starch (for nutritional purposes). That a copious flow of saliva is poured out when sugar is taken into the mouth did not seem to suggest the idea that the function of the saliva was to clear substances out of the mouth which might be or might become harmful to the teeth and mucous membranes during or after mastication. So, again, we were taught that acid vegetable foods gave rise to a copious flow of alkaline saliva rich in ptyalin, but physiologists were silent with regard to the "why" of the ptyalin in this case. That the flow of alkaline saliva was to neutralize the acid was indicated, but that the saliva similarly became alkaline on eating meat was not mentioned, and the rationale of such alkalinity was not indicated. So, too, we were led by physiologists to believe that the reason why ptyalin did not exist in the saliva of an infant till it had reached about the sixth month was that up to this age the child should not get starch in its dietary. No doubt an infant should not get starch in its dietary before this age, but why a ferment from the pancreas capable of digesting starch before this age existed was not told to us. The fact that the appearance of ptyalin in the saliva synchronizes with the cutting of the teeth and that the saliva exists chiefly for the physiological cleanliness of the mouth and for the protection and preservation of the teeth was apparently never dreamt of. Although, then, the physiological reactions of the saliva to food show us clearly that they are adapted chiefly for facilitating disintegration of food and deglutition and for getting rid of certain substances commonly associated with foods which are or might become injurious to the mouth and teeth, it would be a mistake to argue that whatever stimulates the salivary glands should necessarily be regarded as specially desirable food. Rather should we surmise that in foods which stimulate a great flow of saliva there may be an element of danger if for any reason the glands were not capable of responding adequately to the stimulus, or if the food were of such a nature as to hamper the saliva in its attempt to get it out of the mouth. There is, then, an element of danger in food which contains sugar in greater proportion than it exists in vegetable foods as presented in Nature, and the physiology of the glands of oral hygiene indicates that sweets, bread and jam, bread and marmalade, and the like, should not be eaten at the end of or between meals.

I have not referred to mucus. Its function is largely that of lubrication, but it, too, is also instrumental in maintaining hygiene of the mouth, and when thoroughly incorporated with the food during mastication it no doubt facilitates the action of the gastric juice when the food reaches the stomach. Possibly this explains to some extent why, as Dr. Boyd has ably shown, digestion is so very much better when the food requires mastication than when it is given in the form of pap.

Here it may be noted that the various principles of dietetics cannot be altogether isolated from one another, or perhaps we should say that various principles serve to reinforce each other, so it need hardly surprise us that our fourth principle has been adumbrated in what has already been said. This fourth principle is most important not only because of its practical application, but also because it has hitherto been completely overlooked by physiologists. I refer to the principle that *the food should be of such a nature or the meal so arranged that the mouth and teeth will be left physiologically clean at the end of the meal.* When once this principle is stated no one can deny it, for it is simply absurd to say that the mouth should be left in an unhygienic state after meals. In my earlier writings I have so frequently insisted on the importance of this principle that I shall not even trouble you with a recapitulation of the facts and arguments which commend its importance. The wholesale destruction by caries of the teeth in civilized communities, together with the equally wholesale destruction of the gums and alveolar processes resulting from oral mal-hygiene, should have been sufficient to call attention to the importance of this principle, and except among those physiologists and medical men who consider that the mouth and teeth are outside their domain, the principle is now fairly recognized amongst the educated. Since the teeth of animals and primitive man are kept in a hygienic state by their foods, it is a simple guide to say that food in its natural condition will, if taken at the end of a meal, leave the mouth clean. For various reasons I have drawn attention to the value of uncooked fruit for this purpose, and need only add here that, unless we are to revert to primitive foods and eschew all the benefits which accrue from the preparation and cooking of foods, we must above all other principles insist on this one. Moreover, recognition that food should be of such a nature that the mouth and teeth should be left in a hygienic state leads by extension to the idea that the whole alimentary canal should be left in a similar hygienic state, and this suggests a still wider field for investigation. I have read that the alimentary canal of children nowadays is little more than a series of pathological specimens, and although this may be an exaggerated way of putting it, there is too much truth in the remark ; and so long as the craze for nutrition and calorie values is considered, to the exclusion of the hygienic value of food, what truth there is in that observation will remain.

"Science knows no geographical boundaries"; it only recognizes the limits of its own departments. Being under less than no obligation, however, to follow decadent scientific methods, we may be permitted to transgress the boundaries of our specialty and deal briefly with a few principles which have little or nothing to do with the mouth and teeth. They have, however, to do with the hygiene of the alimentary canal. As over-eating is a common cause of alimentary mal-hygiene, I shall deal with a few principles associated therewith. The first I shall mention is well known, but seldom brought into force as it should be among the civilized. It is simply that "*hunger is the best sauce.*" Throughout the whole course of evolution our progenitors must often have been hungry, sometimes very, very hungry. If hunger had incapacitated them for food when it was found, there would have been little chance for them surviving; fortunately, it had quite the contrary effect. Pavlov* has shown by approved experimental methods that digestion goes on best when associated with hunger, and in a general way we all know that it does so. Nevertheless, I have practically never seen an emaciated child with an unhygienic digestive tract treated by keeping food away from it, and the unhygienic state of its alimentary canal is never given a chance of becoming hygienic. The administration of tonics and digestive stimulants generally increases appetite, tending to over-eating, and thereby to derange a weakened digestion and thus inducing further mal-hygiene, while the administration of antiseptics is an admission of the existence of an unhygienic state without attempting to remove the cause. Combined, these drugs indicate the nature of the scientific preparations which exhibit our ignorance of the principles of dietetics.

This leads us to state another principle—namely,

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* Pawlow, J. P., "The Work of the Digestive Glands," 1902.

tempting the palate habitually is contrary to the dictates of evolution. As the importance of economy in nutrition has, throughout all ages, only been transcended by the importance of getting enough, we should recognize that a flagging appetite is a signal that amply sufficient has been consumed. We may be assured that, as in past ages, unlimited supplies of food are seldom available, as much as possible will be eaten of any food which contains the elements for supplying immediate needs and a reasonable reserve for the immediate future without special temptation. One might have thought that a scientist who recognized that hunger was the best sauce might also have recognized this principle. Nevertheless, we read in Pawlow's work on the digestive glands: "The customs of the chief meal of the day also correspond with our physiological results. After this or that *hors d'œuvre,* perhaps also with a liqueur of brandy (especially customary in Russia), both of which are designed to awaken the appetite, the repast proper begins, and, in the majority of cases, with something hot, consisting mostly of meat broths (*bouillon,* different soups, and so on). After this comes the really nourishing food—meat of different kinds served in various ways, or, in the case of poorer people, stews made with vegetables, and therefore rich in carbohydrate material. This sequence of foods, from the standpoint of physiology, is quite rational. Meat broth, as we have already seen, is an important chemical excitant of gastric secretion. An attempt is therefore made in two ways to secure a free secretion of gastric juice to act on the chief food: first, in the excitement of the appetite juice by the *hors d'œuvre;* and, secondly, in the promotion of the flow by the action of the meat broth." It would appear from this quotation, and other similar statements, that no effort, either in the way of chemical or psychic excitant, has to be spared to secure the activity of what seems to be presumed an otherwise insufficient organ for carrying on the work of digestion. Pawlow's* ideas are interesting and instructive; unfortunately, however, they are not principles of dietetics; rather are they principles of gluttony. Much that is written about the arrangement of the meal from the glutton's point of view may be interpreted quite differently and more correctly. The meat or vegetable broth which so frequently commences a meal may have little or nothing to do with stimulating digestion; it may have chiefly to do with economy. A proportion of the available nutriment in yesterday's joint might be lost if the remains were not boiled and the resulting "stock" used on the following day. The words "stock" and "*pot au feu*" both suggest this interpretation. Pawlow follows what I have already quoted with the sentences: "The usual termination of the repast is also, from the physiological standpoint, easy to be understood. The chief meal is generally ended with something sweet, and everybody knows that sweets are pleasant. The meaning of this is easy to guess. The repast, begun with pleasure, consequent on the pressing need for food, must also, notwithstanding the stilling of hunger, be terminated with an agreeable sensation." Let us consider what is meant by "something sweet." Jam rolls, bread and honey, chocolate, etc., may all be recognized as something sweet or sweets, but yet, as it appears to me, his meaning in saying that the meal should be terminated by something sweet, yet which does not burden the work of the alimentary canal at this time, is not at all clear. It is quite obscure unless (which may be his meaning) we assume that sweet things do not burden digestion at this stage. But this would be quite erroneous. He refers also to acids, and attempts to show how acids one way and another assist digestion. He never appears to have dreamed that acids in foods were almost wholly concerned with dental hygiene. In fact, the whole of his arguments indicate a conviction in the insufficiency of man's organs of digestion, except when they are excited, whetted, and tempted by all sorts of psychic and chemical stimulants, and the philosophy of the correct termination of the meal is overlooked.

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* Pawlow, J. P., "The Work of the Digestive Glands," 1902.

That the gustatory secretions should be stimulated at the end of a meal, not by sweets, but by food of a natural, hygienic, or detergent nature, is evident to all who admit the principle that the mouth should be left physiologically clean. Now what does so most effectually? Fresh fruit certainly does: not only the dilute sugars, but the acids, the aromatic and even the acrid substance in the fruit do so most effectually.

Fruit contains but little nutriment, and its real value is hygienic and not nutritive ; much less is it a digestive tonic. Foods in the form of sweets, jam rolls, bread and marmalade, chocolate, etc., are to be condemned absolutely as meal terminals, as their effect is the opposite of fruit, which leaves the mouth in a hygienic state. Read in the light of my theory Pavlov's experiments are, I believe, most instructive. Read in the darkness of the old craze for nutrition they are misleading, dangerous, and contradictory.

The amount of food eaten should not be regulated by principles of gluttony. It should be regulated indirectly by recognizing the principles of dietetics. That the palate is a useful guide is not to be denied, and when it is given a chance to act it acts usefully. If the palate is given the opportunity of discovering and appreciating the quality and quantity of the food which passes it, as when the food requires to be disintegrated and retained in the mouth for a time, then it will be a useful guide. If, on the other hand, food is given in the form of pap and is slipped past the palate without mastication, as it so often is in the feeding of young children and of geese which are being stuffed for *pâté de foie gras*, then the palate is but an imperfect guide both as regards quality and quantity. It may be said that we want to have a guide for future meals, and want to know beforehand the quality and quantity required for individuals under diverse circumstances. If the principles of dietetics indicated are recognized this is easy, as the amount required for to-morrow is under similar circumstances the same as that which was required for yesterday. To avoid too little being provided, provision should be made that a little of a wholesome but not specially tempting kind shall always be left over, and arrangements made for utilizing it on the following day, or for feeding animals or otherwise. You will no doubt say, "But this is just what everyone does, and how everyone does regulate the amount provided daily." Of course it is. My thesis here is that common sense and custom are generally better guides than standard dietaries scientifically based on an erroneous assumption. Nevertheless, let me say that instinct, custom, and common sense are not invariably to be relied upon. A new environment may come into existence relatively suddenly, and the safeguards of necessary limitations existing in the aboriginal environment may disappear. Thus, for example, a relatively unlimited supply of carbohydrate foods may now be easily procured; in addition to this, a gratuitous advocacy in influential quarters of the things most to be guarded against may usurp the place of natural limitations, as, for example, the advocacy of highly nutritious foods, the value of sugar as an economical foodstuff or as a proteid sparer, the advocacy of jam and marmalade instead of butter on bread, or the extolling of cocoa and chocolate to the prejudice of cheaper and more hygienic foods. It is for reasons such as these that we stand in need of something more than instinct and custom. We need the principles of dietetics and a touch of common sense to be able to co-ordinate and make practical use of them.*

With regard to a balanced dietary little need be said; the principles which regulate this, too, are similar to those which regulate the amount. Like the amount, it is very variable, and if the organism (when restraints such as Nature presents are imposed) is not fit to seek for and procure the balanced dietary required, no artificial endeavours will be likely to avail in the long run. The possibility of getting a fair choice and variety is of course necessary. Variety, however, should not simply be with regard to proteid, carbohydrate, fat, etc.; it should include also *uncooked* food. Fresh fruit, vegetables, and gustatory stimulants without any regard to calories are necessary. Throughout the whole course of evolution uncooked food was consumed, and we certainly have not as yet sufficient evidence to make us disregard the probability that certain essential qualities are not destroyed by cooking. Possibly the craze for having everything made easily digestible and sterilized before it enters the mouth accounts for much dyspepsia, and may explain why uncooked milk, though full of germs, is such a useful drug in restoring what is sometimes necessary for healthy digestion. I indicated above that restrictions on eating certain foods should be imposed to compensate for the lost restraints which Nature has imposed.

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* Wallace, J. Sim: "The Prevention of Common Diseases in Childhood," 1912; "The Rôle of Modern Dietetics in the Causation of Disease," 1905; "Dental Diseases in Relation to Public Health," 1914.

If restraints in the nature of taxation for revenue on consuming alcohol, tea, and coffee are conducive to more good than evil, then surely the taxation of sugar, sweets, chocolate, and cocoa might for similar reasons be imposed, for, as Sir William Osler has maintained, decayed teeth are responsible for greater harm to the community than alcohol. Surely the proportion of misery which alcohol causes is not greater than the amount of dental troubles brought on by the eating of sweets. Indeed, Dr. Wheatley's* statistics with regard to sweet eating and caries clearly show this to be the case.

The next principle we may refer to is that *diet and activity are reciprocally co-ordinated.* This is generally recognized, and so we need only refer to the modern doctrine which runs counter to it—namely, that the worry and strain of modern civilization is responsible for much of the prevalent dyspepsia and other ills to which human flesh is heir. The doctrine is generally applied with regard to the well-to-do, and more often than not to Society ladies whose so-called work and worry resolves itself into making numerous calls and indulging in the light chatter which is characteristic of drawing-room conversation. We fail to see the great strain involved in this ; but that those who indulge in it are frequently the subjects of dyspeptic derangements admits of little doubt. The explanation of this fact is probably that the work necessarily entailed on their ancestors in gathering, preparing, and cooking food, in cleaning and looking after the house and helping in the work of tending and bringing up children, has been got rid of by the employment of servants, and the idle time thereby gained is misused on introspection, on gossip about the physiology of the alimentary canal and other internal parts, and about the nutritive value of the latest advertised foods containing concentrated nervous restoratives required for the upkeep of the highly strung machine which has been "run down" by the heavy strain and serious worry which gossip and the failings of servants involve. It has struck me as suggestive that the wives of drunkards and wastrels seem generally to have remarkably good health and digestion. The wives of such men have much to worry about, but their worry is about things external to themselves. They are necessarily very much concerned with their environment, for the effects of drunkenness loom large on their horizon. Fortunately, they have no time to worry about their own physiology, nor leisure for morbid introspection. To cut a long story short, there are two forms of worry. One is external, natural, and beneficent. This latter has been the common lot of humanity throughout the whole of man's struggle for existence. It is the mainspring of work and of most healthy activities. The other form of worry, which is harmful, is introspective, and dependent for its existence on idleness and morbid states of mind and body. This last form of worry is injurious, and its proper antidote is work, not prescribed gratuitously as a medicine, but as a necessity. Civilization and division of labour largely dispense with the necessity of the actual work of procuring and preparing food before meals; still, some form of activity should precede or alternate with meals. Present-day substitutes, such as physical exercises, breathing exercises, skin friction, and ablutions regularly performed before breakfast, have considerable justification from the point of view of evolution. The point in which they fail is that they are done without interest, and without seeing that the activity subserves some useful end, except the rather morbid one of the conscious pursuit of health. There are many activities which would no doubt lead to as satisfactory results if indulged in before breakfast, and the fact that domestic servants, notwithstanding the shocking state of their teeth and the illnesses resulting therefrom, are as a rule relatively healthy makes us surmise that this type of activity might well be imitated by women and even men in affluent circumstances. It would also to a certain extent get rid of the fanciful idea of the "worry and strain" involved in keeping domestic servants.

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* Wheatley, James, School Medical Officer's Reports, County of Salop, for the Years 1911, 1912, 1913.

The next principle we may refer to is that *economy in diet is beneficial physically and morally.* A long sermon might be preached on this subject; it is not, however, my intention to do so, firstly—because it would be more instructive to hear how it is done from the housewife with a family, let us say of five children and a husband with fifty shillings a week; secondly, because it involves other considerations besides calorie or hygienic values; thirdly, because the poor housewife in general does exceedingly well with the money at her disposal compared with those who usually give advice to this class. She does not require to be told that bread, oatmeal, and potatoes are economical compared with many other foods often belauded in medical journals, nor that cheap cuts of meat or cheap cheeses are of as high nutritive values as the more expensive kinds. All that I would say with regard to this principle is that to judge the value of a food by laboratory tests regarding its calorie value has been, and is, most misleading. A food such as uncooked fruit may have a high hygienic value. This may at times be wanted, and what is not wanted, even though it has calorie value, is valueless when it is not wanted. Moreover, the estimation of the cheapness of food by the amount of calories procurable from a given sum has led to the wholesale distribution of advice which is worse than useless. Because an amount of sugar representing a large number of calories can be bought for a relatively small amount, it has been argued that sugar is an important and valuable food *for the poor*. Since, however, force of circumstances compels the poor to obtain the great bulk of their nourishment from bread or cereals and potatoes, and inasmuch as these contain relatively a superfluity of carbohydrates, every penny spent on sugar by the poor is from the point of view of nutrition simply wasted. But this is not all. The sugar is often taken in a particularly obnoxious form, either as sweets between meals or as jam spread upon bread. Not only, then, is the money spent on the sugar wasted, but the fruit which is made into jam has most of its virtues destroyed as far as oral hygiene is concerned, and this at the considerable expense which is entailed in reducing it from the hygienic and palatable form in which Nature provides it to the unhygienic form in which we see it prepared to destroy the teeth.

Another principle which should be considered by those who issue dietetic precepts is that *functional activity is generally necessary for the most perfect development of an organ.* A conspicuous illustration of this may be seen in the muscular development of the blacksmith's arm. This principle applies also with regard to the development of the salivary gland, and probably also to other glands for the hygiene of the alimentary canal. Similarly, without any doubt, the muscular development of the organs of digestion is affected by the physical nature of the food. This is notably so in the case of the muscles of mastication ; moreover, the development of the muscles of mastication has a distinct influence on the development of the jaws, and this again has its influence on the arrangement of the teeth. The anatomical perfection, then, of the first part at least of the digestive apparatus of man is quite appreciably affected by the physical nature of the food consumed in childhood.

I might refer to other principles which indicate, for example, that eating between meals should be avoided;

that the concentration of the different elements composing foods (especially sugar) should not exceed the concentration habitually found in such foods as man must have subsisted upon throughout his evolution; that three meals a day are to be preferred to any greater number, etc. But as these and other principles dealt with in this paper have been gone into in much greater detail in my books there is no need for further elaboration at present.

I should, in conclusion, however, like to refer to some reasons for bringing forward this communication. One general reason is to indicate that principles of dietetics may be formulated. Nevertheless, we need not be too sure that those whose business it is to deal with diseased states will formulate them, because if there are any principles with regard to dietetics among the diseased, they would by no means necessarily be the principles which obtain in health; indeed, we may perhaps truly say that one diseased man's food is another diseased man's poison. Similarly, the principles of dietetics or the value of foods cannot be established by those who set up laboratory tests and standards as criteria. Nor can they be deduced from the most elaborate statistics having reference to calorie values. The accumulation of statistics on nutritive values, however accurate, gives no more guide to hygienic values than do hygienic values give guide to nutritive values, and the use of such statistics as a basis for generalizing only prevents us from doing what science ought to do—namely, to methodize knowledge and reduce it to principles. Further, we must be practical. Principles are merely of use as mental formulæ for the sake of doing something for human welfare. The pursuit of science for science's sake is, as a rule, merely an excuse for inability to discover principles which are of human utility. My special reason for bringing this communication forward is because I feel confident that all members of this Society have in their own practice seen the awful havoc which has been wrought in the mouth, and more especially the teeth, of the people through the misguided teachings of those who have in the past expounded the principles of dietetics to the medical profession and so indirectly to the public. I feel sure that each in his own way will try to bring home to the teachers of medical students the urgency of perhaps the most important, though as yet unappreciated, principle that I have brought forward this evening—namely, that the meals should be of such a nature that they will leave the mouth physiologically clean. I know it is difficult to gain the ear of those who stand on high pedestals. I know that it may be galling for those who teach and think they are leaders of thought to be themselves taught and to have their own thoughts led. Yet the dental profession is undoubtedly at present able to direct the teachings of scientists as regards diet; indeed, it has been said that "in the last few years the diet of children has been entirely reconsidered. Much of the traditional feeding has been rejected, and in its place a carefully thought out dietary, based on scientific principles, has been established," and that, moreover, "it is to the dental profession that in the main we owe these advances." Similarly, it has been admitted that "we have now quite outgrown the notion that dietaries can be scientifically constructed by a mere estimation of calorific values." Referring, however, to the oddly unfair attitude taken up by many with regard to some of the most signal triumphs of preventive medicine, a reviewer of a book said: "Dental disease is a striking instance of this attitude. Without demanding any absurdly stringent regulations of one's daily life, without asking any expenditure of public money, dental disease can be almost entirely prevented. But how little stock is taken of this striking triumph of our art. . . . It is useless waiting for the heads of the profession to take it up; the general practitioner can do much to bring about the change."

But these observations have been made by individual medical men. I have not yet seen such admissions made by accredited teachers of medical students. Nevertheless, until the distinguished professors of physiology appreciate and teach the principles of oral and alimentary hygiene, the teaching of which could prevent more suffering than any hitherto discovered physiological principle, it will take us a long time to effect the result for which both principles and professors should exist. It must surely stimulate all of us to think that we are in the position of those pioneers of science who, having brought forward and elucidated new thoughts, stimulate fruitful investigation. Our case is amply sufficient not only to justify, but to compel careful and accredited workers in physiology and physiological chemistry to turn away from blind-alley researches to the scientific investigations of numerous details connected with the subject of this communication in the new light that promises the most fruitful returns. It may be that in the immediate future we shall be treated as common dentists whose directions are to be regarded with disdain. Or it may be that the roads that are leading to fruitful results will be claimed to have been opened up by those who have been directed by us. That need not disturb us at present. What we want first is to see that the teeth of each succeeding generation are less and less ravaged by decay. We want to be able to note that the ugliness resulting from ill-developed jaws and ruined and misplaced teeth, which blight every second face we look upon at present, will gradually give place to beauty of form and fitness in function of this conspicuous and important part of the body. We want to be able to show that pyorrhœa, with all its odours and disastrous results, is being controlled and made rare ; and, finally, we want to see dyspepsia, resulting from continuous dietetic error, more or less completely banished.

I am convinced that all this can and will be done by all intelligent and moderately careful people, *provided the true principles of dietetics are elucidated by those in influential places.*

CHAPTER III

CHILD WELFARE AND THE TEACHINGS OF SPECIALISTS

"Oral hygiene—the hygiene of the mouth—there is not one single thing more important to the public in the whole range of hygiene than that."—SIR WILLIAM OSLER.

IN recent years a great deal has been said with a view to ameliorating the health of the rising generation. It is generally assumed by those who write or preach that much good will be done if their advice be followed, as they assume it ought to be. But to do the good which we all desire we have at least to consider three things: Firstly, we have to consider whether the advice given is really good. Secondly, we have to consider whether there is sufficient unanimity among authoritative exponents of the subject to insure freedom from that conflicting advice which gives rise to a tendency on the part of the public to disregard any advice coming from expert sources. Thirdly, we have to consider whether the exponent of any particular doctrine which may be conducive to the health of children is a right and proper person to undertake such duty or responsibility, and whether the method taken is efficacious or otherwise.

To indicate roughly, but more exactly, what I mean, let us assume that oral mal-hygiene is primarily or essentially the result of dietetic error, and that oral hygiene normally and naturally is a physiological process, depending largely on the physiological activities of the salivary and mucous glands. Is it the dentist or the physiologist or the dietetician who should teach or preach to the public on these subjects ? If it be either one or another of these distinguished specialists, which is to be regarded by the public as authoritative ?

Suppose the dentist, the physiologist, and the dietetician were each to give a lecture on oral hygiene from his point of view, are we sure that the man in the street would not be acting perfectly sensibly if he disregarded the conflicting advice which he would be sure to hear from all three ? My impression is that the common sense of mankind is sufficiently good to justify all who do not claim to have special knowledge in disregarding what they hear from experts until there is something like unanimity among them.

On a recent occasion when I was invited to address a body of social workers in regard to the care of the teeth, I felt it incumbent upon me to lecture practically wholly from the point of view of the physiologist and the dietetician.* But I believe the subject of oral hygiene and dietetics should be taught by physiologists and not by dentists. If this be so, and we dentists have something with regard to the physiology and hygiene of the mouth to convey to the public, surely it should be our endeavour to reach the ear of the physiologists or those who are in such authoritative positions that we may be able to rely upon the public paying attention to what we have to say.

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* Lecture published *in extenso* in the *British Dental Journal*, April 2, 1917. The concomitant booklet which I prepared for social workers, etc., is issued by the Public Health Department of the Corporation of Birmingham.

Again, we want the public to do certain things which are conducive to oral hygiene. To me, at least, it would seem that the best method of arriving at this is not to give the so-called ignorant mother details of physiology to influence her mode of bringing up children, but rather to present the subject in such a way that the most intelligent and the most influential people will adopt a system or intelligent and rational mode of bringing up children, so that oral hygiene will be characteristic rather than otherwise among the children of wise, progressive, and influential physiologists and medical men. If this be done, it will not take long before it is generally adopted by the mass of mankind, who always are and ought to be guided rather by example, custom, and instinct, than by what to them may seem to be the fads and fancies of cranky scientists. We often hear mothers blamed for ignorance, apathy, negligence, etc. Great pride is taken in unrolling a mass of knowledge with regard to physiological details, but as in the past, so in the future, instinct, custom, and ceaseless care will play a far more important rôle than burdening mothers with knowledge of physiological and anatomical details with regard to the internal construction and function of their children. A knowledge of physiology and anatomy has its place, but before such specialized knowledge is insisted on, surely the more general, the more useful, and the more interesting knowledge which can be derived from a study of the history of man and his institutions, including the evolution of domestic habits, meals, etc., should be appreciated.

This is by way of introduction; what I want particularly to insist upon is that physiologists and not dentists should teach oral hygiene. What they say with regard to food, the physiology of the saliva, and mucus, is authoritative. It is taught by them to thousands of medical students annually. These medical students become doctors and pass on what they have been taught to thousands and thousands of mothers and to the public generally. If we dentists have anything to say which conflicts with what physiologists teach, a hundred times the number of medical men in authoritative positions pay no attention to us, and continue to teach what they were taught by physiologists and sneer at our effrontery in trying to teach them the physiology of oral hygiene, if indeed they trouble to honour us with a thought at all. I grant it is extremely difficult to teach medical men anything about the physiology of oral hygiene—at least it was—but it is still more difficult to reach the ears of physiologists. Medical men are on pedestals, but the pedestal on which the physiologist stands, more especially if he writes the three letters F.R.S. behind his name, is so high that in my experience, at least so far, it has been impossible to get the sound to rise as high as his ear. And here is our difficulty: the dice is heavily loaded. What we say is negligible as compared with the words of the physiologist—the value of anything which we may explain is counteracted by the slightest word from him. It is thought incredible that we can teach the physiologist anything about physiology. Indeed, the physiologist does not even mention the words oral hygiene in his books. When we have insisted on the physiological nature of oral hygiene we have been ignored.

So far I consider that we dentists have failed to do anything effectual in the way of teaching the public generally or in introducing beneficent customs with regard to oral hygiene, and the reason is that we have failed to get the physiologists to take up or support our contentions, and to get authoritative approval or to have it taught to medical students.

I wish now to do two things: Firstly, to make it evident that the teaching of physiology as at present carried out is worthy of severe censure where oral hygiene is concerned; and, secondly, that the prestige of physiologists has hitherto made it wellnigh impossible for us to reach them to overthrow their bad teaching.

To illustrate how we dentists are treated, let me refer to certain contributions which I have made on certain subjects associated with the physiology of the mouth.

In 1900 I wrote a short paper entitled "The Physiology of Mastication." This was sent in the first place to a leading medical journal, but it was not appreciated. It was returned to me with or without thanks. I then sent it to a dental journal, where it appears to have been appreciated, and printed as the first original communication. It was, moreover, reproduced in an American journal. I had, however, failed in my object. The subject was the physiology of mastication. I drew attention to the erroneous teaching that prevailed, and singled out for special criticism the description of the process as given in "Huxley's Physiology." I then had it reprinted and sent it to the editor of "Huxley's Physiology" in the hope that he might see the error and correct his description of the process in some succeeding edition. Time passed, and I was pleased to see some ten years later that my views on the physiology of mastication had been appreciated and fully quoted in Colyer's "Dental Surgery and Pathology," so that I had the satisfaction of knowing that when dental students came to study dental surgery they had the opportunity of unlearning the erroneous teaching with regard to this subject which they had learned when they attended their class of physiology. Five years after the publication of Colyer's textbook another edition of "Huxley's Physiology" appeared. Do you think the editor of that classic paid any attention to any views of mine, or to what dental students were being taught? No, the same fallacy with regard to the physiology of mastication reappeared, and to indicate cast-iron resistance to any amelioration suggested by us, the same words were used as in the previous edition. I have referred to this more fully than I intend to refer to similar instances with regard to different subjects which I propose to speak about, because it is more or less characteristic of my fortune or misfortune in general. I might, however, add that there are one or two hopeful signs. One distinguished lecturer, I understand, who in his earlier years taught physiology to a class of dental students, told them that Huxley's description was all wrong, and proceeded forthwith to tell them what was right. Since then he has become a Professor of Physiology at one of our renowned Universities, and I have at least been told that a description of physiology similar to that inculcated to dental students has appeared. Whether the writer is or was a recognized physiologist I do not know. It is gratifying, however, to be able to know that the ideas taught by dentists are appreciated or supported by some writers outside their own rank.

Associated with the erroneous description of the physiology of mastication there went an erroneous reference to one of the functions of the mucus and of the saliva. It was asserted in "Huxley's Physiology" that the bolus was enveloped in saliva. In Pawlow's work on the "Work of the Digestive Glands" it was asserted that the mucus lubricated the bolus of food formed during mastication. As, however, the bolus or mass of food taken into the mouth is disintegrated and made into a semi-liquid state before swallowing, it is as absurd to speak of the mucus enveloping the bolus to facilitate deglutition as it is to say that it is "collected, enveloped in saliva," and made into a bolus. Indeed, in general it may be said that the true physiology of the mucus has never been appreciated by physiologists at all. That mucus lubricated the mucous membrane has always been recognized, but that the mucus formed a tenaciously adherent film on the teeth which prevented certain foods adhering to the teeth or injuring them, and facilitated the removal of food particles from surfaces of the teeth, was not, I think, made clear. We were told that acids precipitated mucus, but we were not told what physiological purpose this might subserve. To us it is all quite clear since we have come to recognize that the mucous glands are important glands of oral hygiene, and although Professor Geis, a great authority on mucus and saliva, has corroborated our views on this subject, I am not at all sure that physiologists in general have taken the slightest heed of our teaching. Moreover, its unique properties, which make it so efficient in helping to remove food particles from the mouth and in keeping it clean, are still not taught to medical students. Physiologists have always been extremely keen on explaining to us the physiology of digestion, yet it never seems to have occurred to them that the thorough incorporation of mucus with food during mastication may be a great help to digestion, for since mucus forms a flocculent precipitate when treated by acids, we can well see, what has been established by X-ray experiment, that food demanding efficient mastication, and consequently which has been thoroughly incorporated with mucus, is more readily digested than food which is reduced to a pappy form and swallowed without mastication. We were taught that food in a finely divided form was far more rapidly acted on by the gastric juices, and experiments were made to show us this in a glass bottle. We were not told of the necessity for having such food thoroughly incorporated with mucus to facilitate gastric digestion.

When we turn to consider the physiology of the saliva we notice here, too, how much has been taught in the most erroneous and slipshod way. I have had many medical men as patients, and have frequently asked them what the function of the saliva was. The invariable reply to this has been—to digest starch. They never even yet seem to have heard of or thought of the saliva as being useful for protection of the teeth or for oral hygiene. Yet after a little conversation these medical men have always come to appreciate the view that to consider the salivary glands as digestive glands is quite erroneous, and to look upon them, as we do, as glands of oral hygiene is undoubtedly correct. In addition to the salivary and mucous glands, the glands of Serres very probably, and the amœboid phagocytic corpuscles in the saliva certainly, contribute to physiological oral hygiene. Nature appears to put great importance on physiological oral hygiene, however little physiologists do. Yet physiologists are apparently still oblivious of the fact that the salivary and mucous glands are primarily glands of oral hygiene, and, true to their old misconceptions, are still perplexed with problems which seem rather tantalizing to them, as, for example, that before the ptyalin has had time to have an appreciable effect in the digestion of starch it is passed into the stomach, where its action quickly becomes arrested. To us who believe that this function of the liquefaction of starch is, from the point of view of oral hygiene, of value *when starchy food particles remain in the mouth*, there is, of course, no incongruity or anything to be wondered at at all.

Associated with an appreciation of the true functions of the saliva and mucus which we have just referred to there goes the important dietetic principle or precept that the physiologically correct type of meal is of such a nature or so arranged that it will leave the mouth physiologically clean. I have never as yet come across any physiologist or medical man who has dared to say that the meal should be of such a nature or so arranged that the mouth and teeth will be left dirty. Yet their precepts and practices would rather indicate that they have a preference for such types of meals. It may be contended in the future that the types of food which we dentists indicate as leaving the mouth and teeth clean or otherwise are not correct in all details—possibly they may not be. Nevertheless, we have established a most important principle which was overlooked in the past, and is not at present taught by physiologists. There is something pardonable for dentists in their old injunction to brush the teeth after every meal, for they knew that when the dictates of dietetic specialists were carried out, the mouth, as a very general rule, did require some artificial form of cleaning. It is relatively unpardonable for physiologists not to recognize or to have recognized that the mouth is naturally kept physiologically clean, and should not, under a proper dietetic régime, require the teeth of man to be brushed to keep them healthy.

There is a certain class of food which for a century or more has been considered by dentists, if not a source of oral mal-hygiene, at least a cause of dental caries, and this view was generally known and appreciated by the public to some extent until, following the lead of Herbert Spencer, the whole medical world came to consider sugar or sugary foods as excellent, if not essential, in the dietary of children more especially. Possibly the views held by the late Dr. W. D. Miller tended to some extent to make the dental profession waver in its attitude towards sugar and the oral mal-hygiene associated therewith, and certainly the failure of the dental profession in the nineteenth century to explain why the eating of sugar-cane did not cause decay in the teeth did not tend to check the amazing doctrine that sugar was a cheap and valuable food devoid of harmful effects with regard to the teeth. Of course, as you know, the idea was fostered and fanned by the "scientific" experts, who, looking at the subject from one point of view only, were able to prove, or to think they proved, the great value of sugar with incontrovertible figures and experiments. The views of dentists were, of course, ignored. Questions of oral hygiene must not be allowed to be taken into consideration when "science" has determined that caloric value is and must be the one and only consideration. I do not forget, of course, that there are now notable exceptions in the medical profession, and that here and there we are occasionally listened to. I need only refer to Dr. Wheatley's excellent and memorable investigation into the relationship between eating sweets and dental caries. Although we may be ignored and despised by the learned dietetic experts, I think that on this subject there is ample evidence that the bubble has been pricked, and I feel sure that we are not indebted to professors of physiology or dietetic experts for having brought home our ideas to a large section of the medical profession. We are, however, largely indebted to Dr. Harry Campbell, who has more continuously upheld our way of looking at the matter than any other medical man, and, looking at it from a reasonable point of view, has asked the reason for "this strange belief in the special food value of cane sugar." The purport of his contentions, which appeared shortly after the war commenced, may be gathered from the heading, "Do without Sugar—Fallacy of its Food Value—National Saving." But it was in 1910 that we, in our section of the Royal Society of Medicine, and again in 1915, pointed out the fallacious belief as to the value of sugar. We contended that, as the amount of carbohydrate in potatoes and cereal foods, such as bread, is proportionally great, and that in order to get a sufficiency of proteid from these, the cheapest sources, an excess of carbohydrate is sure to be consumed, thus any money spent further on a carbohydrate such as sugar is simply wasted, and so to talk about sugar being "perhaps the cheapest food" or a great "proteid sparer," when already too much carbohydrate and too little proteid have been consumed, is on a par with sending coal to Newcastle. This may remind you of my argument from the point of view of economy, which perhaps more than any other has confounded the views of dieteticians, notwithstanding the fact that they imagined they had conclusively proved the value of sugar by approved experimental methods and all "the trappings and the suits" of science.

The following quotation from a leading article in the *Medical Times* (January 30, 1917) will indicate how the medical profession, or at least those who are impartial and interested, have come to champion our way of thinking. It runs:

"Perhaps the greatest mistakes in the dieting of infants occur at the time of weaning, and radical changes in the ordinary diet are required if not only dental caries is to be prevented, but also other infantile ailments. The usual plan is to give cow's milk in some form and to supplement it with patent foods or pap food, such as bread soaked in milk. If one thinks for a moment it seems incredible that such a diet should be prescribed for an infant just cutting its teeth, seeing that they are composed of the hardest tissues in the body, and are, therefore, meant to get hard use. . . . Thus, although milk must still be the child's chief food —it is sometimes more palatable if made into thin, unsweetened custard with an egg—give him bones without jagged ends to exercise his teeth upon, such as rabbit or chicken or chop bones. In addition, at weaning time he should get sips of water and fresh fruit juice, such as orange juice. The juice should not be squeezed from the orange and given in a spoon. Rather let the child have the enjoyment of squeezing it out for himself, by the nurse or mother holding a section of ripe orange (from which the pips have been removed) by one end and letting the child suck and gnaw the contents out from the other, then throw the husk away. A few months later, say at fifteen months, a well-toasted crust thickly spread with butter or dripping may be added to the diet. The two great pitfalls to avoid are sweetening of the food and the giving of pap. Regarding the former there is an almost ineradicable belief that the craving for sugar is a natural instinct in a child. Thus Dr. Woods Hutchinson, of New York, speaking on this subject at the International Congress of Medicine, London, 1913, said: 'The demand for sugar showed that the child's economy demanded sugar, and to deny it would be to starve its system. You might improve its teeth, but ruin its body. It was surely better to have a healthy child with inferior teeth than a semi-starved creature with very beautiful teeth.' Surely this shows a complete misunderstanding of the whole subject of dietetics, and is just one of those bogies that is always raised up when any reform is advocated. It is contrary to all our knowledge, biological and clinical, to argue that a diet which is bad for the teeth is good for the rest of the alimentary canal, and therefore for the whole system, or *vice versa*, and yet this is a statement made every day alike by lay people and by physicians. It is an interesting fact that sugar with one exception (honey) always occurs in Nature mixed with a very large proportion of acid salts and of detergent fibrous tissue, and it is in this harmless state only that the child should get his sugar—namely, as ripe uncooked fruit. If the sugar allowed the child were extracted by him from, say, sugar-cane, he would have to perform a lot of work to get a small quantity, and therefore would not get an excess of it, and what he did get would be in a form that is absolutely harmless. What should be condemned is the giving of sugar in an unnatural, too concentrated form, such as jam, sweets, chocolates, cakes, etc., and especially at wrong times. It should always be remembered in connection with sugar that the craving for it is very easily acquired, and long before anyone is aware of it the child is getting an injurious amount. The addition of sugar to a sufficient diet of bread and potatoes is a case of carting coals to Newcastle! . . . How very true is the saying, 'Prevention is better than cure.' In our opinion, dental caries and diseases arising therefrom could and should be prevented, and in the case of children especially such disabilities are far more easily and cheaply prevented than cured."

This quotation has, I am sure, a familiar ring about it to those who have been accustomed to reading the *Dental Record* during the last ten years or so.

But who has ever heard of a professor of physiology writing these truths in a textbook or teaching them to a class of medical students, and acknowledging therewith his indebtedness to the dental profession? Possibly by this time there may be such professors, but I doubt it very, very, very much, and I have not heard of them. Before many years this may be done, but I never expect to see the dental profession recognized by physiologists, even as it has been by medical men, for having brought forward and for having succeeded in establishing these simple truths which one day will do a world of good, not only with regard to the teeth, but also with regard to the general physique (and pockets) of all future generations. Years ago I foresaw the likelihood of physiologists not teaching our views, in which case I maintained that in such an event, if the teeth of the next generation were to be saved, it would be necessary for Medical Officers of Health and School Medical Officers to push still further forward the campaign of instruction themselves, for the need of a campaign to ameliorate the deplorable conditions of the teeth is most urgent. I am glad to be able to say that school Medical Officers and Medical Officers of Health recognize this, and they have in their own way done what has seemed best to them to initiate this most desired change. Some few—I am afraid very few—like Dr. James Wheatley, have studied the matter thoroughly for themselves, and endeavoured to teach their assistant doctors and health workers what is most necessary for bringing correct knowledge to those who have the care of children. Others have engaged the services of dentists to bring home the principles which we advocate to social workers. Let me call special attention to certain views commended by Sir George Newman, Chief Medical Officer of the Board of Education, in his Annual Report for 1916. He says: "There are various physiological means by which the teeth are kept in good condition. There is, for instance, (*a*) the saliva, which performs functions of a (1) cleansing character, and which also (2) controls fermentation and (3) aids in the protection of the teeth; (*b*) sufficient exercise of mastication, which furnishes a self-cleansing process for the mouth; (*c*) a suitable dietary containing detergent forms of food." I think you will search his report in vain for the belief in imaginary boluses of food lubricated with mucus or for imaginary functions of the saliva, but you will see clearly, not only from this quotation, but from a perusal of previous reports, that he appreciates our views and lucidly expresses and epitomizes them. Is it not exasperating that the work of the most eminent School Medical Officers, who are endeavouring to ameliorate the deplorable condition of the teeth of children, together with the ailments associated therewith, should be stultified by the aloofness, apathy, and ignorance of those whose authoritative position gives them such power to prevent progress, when indeed their authoritative position should be used to promote it without delay? Considering the importance of a clean and healthy mouth, and considering that mastication of suitable foods aids cleanliness of the mouth, and that the saliva and mucus are essentially glands of oral hygiene, is it not despicable that physiologists should continue to teach the nonsense which was taught to their grandfathers and to ignore the fact that the future welfare of millions is jeopardized to a large extent by their apathy or conduct? I suppose they may say in defence that they want proof and experimental evidence. They can get it in the literature of the last eighteen years if they like,* but as a matter of fact to some extent the physiological and dietetic principles referred to are of such a nature that, if once stated and elucidated, they carry conviction. And however desirable further experimental evidence is to bring home truths to the ignorant, some of those which we refer to are so obvious to those acquainted with the order of Nature that some converts have said, much as Huxley did on first learning the theory of

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* *E.g.*, "Some Recent Investigations and their Bearing on a Theory of the Causation of Dental Caries," *Dental Record*, November and December, 1913; January and July, 1914. With regard to four of my earlier books, the editor of the *Dominion Dental Journal* said "these four books have set more people thinking than anything else written in dentistry." But it should be noted that my books do not deal with dental surgery, but with questions of biology, especially those involving questions of heredity, physiology, developmental anatomy, and pathology.

Natural Selection, " How very simple ; it is curious that we did not recognize all this before."

We come now to certain considerations of a more complex nature involving not only physiology, but also developmental anatomy and certain other biological principles. Oral hygiene is not helped by abnormal or faulty development of the jaws or teeth ; nevertheless, such abnormal and faulty developments are extremely common. I should like to refer to three of these. The first is abnormal articulation or occlusion of the teeth. This is one of the commonest general abnormalities, and one of the most incurable. We have ample evidence that such abnormalities were not common in past ages, and we likewise know that they are uncommon in savage races. I do not know that there was any generally accepted explanation of why infants, when they are about to and after they have cut their incisor teeth, have the instinct to gnaw. Indeed, it must seem strange to those who are obsessed with the idea that everything must be aseptic within the range of an infant, that before antiseptics were introduced infants should have acquired the instinct to put almost anything into their mouths which they could gnaw and suck. When, however, we realize the importance of correct occlusion and to some considerable extent the dissociated development of the upper and lower jaws, we observe the extreme importance of the instinct to gnaw, in that it gives the infant the means of co-ordinating the relationship of the upper and lower teeth.

This, in brief, is at all events my view, and it is supported by other members of the dental profession.

The second point to which I would make allusion is the idea that the development of the jaw is influenced in an important way by the developing tongue. My views on this point were perhaps at first derided, nevertheless they receive encouraging recognition in recent textbooks, and to indicate this I may refer to some generous remarks by a past President of the British Society for the Study of Orthodontics. In his presidential address he spoke of three epochs in the progress of the science of orthodontics, and with regard to the point under consideration he recalled the meeting at which I originally brought forward my views, and, referring to me, said: "He had seized and emphasized a fact of enormous importance, and though he was laughed at at that meeting, he has lived to see the truth and other truths he has brought before the profession widely adopted." *

The third point with regard to the development of the jaws and the abnormal arrangement of the teeth is mouth-breathing. For many years this has been recognized, but the cause of the mouth-breathing, or the fact that mouth-breathing was becoming more frequent—at least up to some seven or eight years ago—was not. At that time I brought forward the theory that the prevalence of adenoids and mouth-breathing were directly and indirectly the result of compelling

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* Wm. Rushton, President of the British Society for the Study of Orthodontics, *Dental Record*, 1911.

young children to sleep throughout the cold and damp winter nights with open windows. Some laryngologists knew of the ill effects on the mucous membrane of cold and damp air, and realized that the depressed vitality to which they gave rise not only caused congestion, but also increased the liability to infection of the mucous membrane of the naso-pharynx. Nevertheless, they did not raise any objection to the open window on cold and damp nights; indeed, they encouraged it as thoughtlessly as did other members of the medical profession. I am quite aware that my views on this point were at once challenged. But I wanted statistics, which alone could have defeated my ideas, because my views were acceptable in many quarters both to comfort and instinct, and what was published in the *Lancet* was soon published in many lay journals. I know that several laryngologists were soon convinced that my theory was correct. I understand, moreover, that statistics were taken in a certain hospital and that my views were corroborated. Nevertheless, these statistics were not published. One doctor, however, let the cat out of the bag and told a patient the truth, as a secret, and this patient told the secret to me. Would it not have been better for the rising generation if a clean breast had been made of it, so that the evils resulting from cold and damp air might have been rapidly put an end to, instead of simply keeping silent and letting people revert slowly to what our teachings and their instinct and common sense naturally tend to make them do?

Let it be noted, however, that two things have happened in recent years: Medical men have not insisted, or not insisted to the same extent, on the open window in cold or damp weather, while some have advocated that under such circumstances it should be kept shut; and, secondly, that there has been a decrease in the frequency of adenoids and mouth-breathing.

There was a little point which I brought up some eighteen years ago which may illustrate in another way the attitude of "scientific" specialists towards our views. It was thought by anthropologists that the chin of man was an outgrowth, as it were, which came into existence long after man became man. I had the opportunity of speaking to a distinguished anthropologist who at the time had some skulls beside him. I referred to the view that the chin was not an outgrowth in more recent man, but that it resulted from the alveolar process having come to occupy a less forward position—that is to say, that the alveolar process had changed its position and the teeth had become more erect, not protruding forward in the incisor region as they did and do in the lowest types of men. I told him that the body of the jaw from the angle to the chin was at least as long in savage skulls, where the chin was not pronounced, as in the civilized jaw, where it was. He had calipers in his hand, but he would take no notice and would not measure and compare. Another very distinguished scientist who did not believe in the inheritance of acquired characters, and consequently should have been sympathetic with my view, had the subject brought before him, but, possibly because he himself had referred to the supposed outgrowth of the chin, seems to have ignored my view altogether. The only bit of luck with regard to this interesting little problem that I have had was in a discussion with a worthy professor at one of our dental meetings. I brought forward my view with regard to the chin, and he agreed with me at once and mentioned that he had always thought so before. Whether we each came to the view independently or not I know not, but if our view becomes generally accepted it may be of interest to the dental profession to know that this view was published in the *Journal of the British Dental Association* twelve years before this incident.

I might refer to several other problems to show how apathetic accredited scientists are with regard to subjects brought forward and upheld by the dental profession. As it is chiefly through the accredited scientists that we can hope to do any really appreciable good it is obvious that we must do all we can to get physiologists and other scientists to listen to us. So far, notwithstanding all that the dental profession, School Medical Officers, and Medical Officers of Health have done, no physiologist or anatomist seems to have taken up the subject either to further it or by his criticism or investigations to throw any light on these subjects upon which so much human welfare depends.

My little experience leads me to note that the very class of men which professes to wish the encouragement of science harbours the very individuals who discourage it most resolutely in actual practice. Indeed, I feel sure that there would be little or no need for artificial or financial encouragement of science if justice were done to those who deserve it. It is probably correct to say that a painfully large number of those who have contributed to the discovery of truth, and to the methodizing of knowledge and reducing it to principles, have suffered from every available weapon that could be devised or thought of for their discouragement. If nothing worse be said, it may at least be contended that would-be scientists who are nothing but learned specialists suffer from human nature.

I think we have excellent grounds for hope. Consider the course of the campaign and its results so far. Firstly, the subject was taken up from the point of view of the causation and prevention of dental caries and the irregularities of the teeth. Whatever may have happened at first does not now much matter; suffice it to say that the views brought forward have been substantially accepted throughout the British Empire and to a very considerable extent in foreign countries.

Next, the subject was brought forward in such a way as to try to attract the attention of those interested in the science of dietetics. Here again we can now claim very considerable success—at least, if we judge by some books and articles which have been published lately in England by medical men interested in dietetics.

Again, it was brought forward with special reference to the diseases of childhood. Here again success attended our efforts, and many School Medical Officers have acknowledged the wisdom of our teaching. Not only so, but if you care to read the report for 1916 of the School Medical Officer of Health for Shropshire you will note that many of our conclusions "have been confirmed by investigations in connection with school children in this county and by laboratory experiments." Again, we brought the subject forward from the point of view of public health, and once again we may claim that public health authorities have recognized the value of our teachings and have issued instructions to their health workers based thereon, and in the case of Birmingham, at least, actually written by an extremely close adherent of the views which I am putting before you. Likewise, many important public health bodies and interested branches of the medical profession have invited me and other members of the dental profession to expound our views at their annual meetings.* Moreover, in addition to the full acceptance of my views in the textbooks for dental students, the latest little books by authoritative writers intended for public instruction inculcate our teachings, each with handsome recognition—"The Care of the Teeth," by A. T. Pitts, M.R.C.S., L.D.S.; "The Story of the Teeth and How to Save Them," by F. Trewby King, C.M.G., M.B., B.Sc. (Public Health).

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* *E.g.*, Royal Sanitary Institute, Exeter; Royal Institute of Public Health, Buxton; Society of Medical Officers of Health, March, 1912; British Medical Association, Public Health Section, Liverpool; British Medical Association, Medical Sociology Section, Aberdeen; British Medical Association, Section of Odontology, joint meeting with Sections of State Medicine and Industrial Diseases, Birmingham.

In the face of all this, is it possible for "scientists" to remain aloof from the subject and actually continue to teach what many medical men are now amazed at ever having believed themselves, and still more amazed that even at the present day students are being taught the fallacies which were taught twenty years ago? Only the other day a medical student told me that his teacher had been teaching his class that the reason why some people were unable to swallow a pill was that the bolus was not big enough for the pharyngeal muscles to grasp in order to pass it down the œsophagus!

If in the past medical men and their teachers could ignore the teeth and the hygiene of the mouth so far that the one never taught anything worth learning and the other never thought it his business to know anything about the subject, can they still maintain this attitude and let it be seriously contended that at least half the diseased conditions of the mouth and the many diseases resulting therefrom are attributable to their erroneous teachings and ignorance? Difficulties and obstructions have always been put in the way of new ideas, even when they were not originated by dentists. Nevertheless truth will out, and arguments based simply on what specialists have taught will not stand permanently. Authorities have in the past often stood in the way of progress, but they lose authority when they stand in the way of truth, fact, logical argument, and human welfare.

We need not despair because our views raise opposing forces similar in nature to those that crushed Semmelweiss, nor even in addition to this because we be dental surgeons. Wells may have been discredited and but little cognizance taken of Morton during their lives, but that one of the greatest triumphs of *surgery* was due to those two *dentists* is now admitted by all honest and learned men, while the treatment meted out to Semmelweiss will ever remain one of the pitiable tragedies which dishonoured the medical profession of his time.

CHAPTER IV

THE DUTY OF THE STATE TOWARDS THE CHILD—THE DENTAL POINT OF VIEW

> "All the suffering and all the ill-health resulting from diseased teeth is preventable. . . . It cannot be too widely known that dental disease is a *preventable* disease, and that it is in the power of the community, if not to abolish it, at least to reduce it to an enormous extent, and with it a very great amount of ill-health."—A. T. Pitts, D.S.O., M.R.C.S., L.D.S.

Generally speaking, a healthy individual is an asset to the community, and an unhealthy individual a burden. It is recognized in civilized countries that the abandonment of unhealthy individuals to disease or death cannot be permitted by the State, and consequently the burden of supporting and curing the diseased falls upon the healthy worker. The burden thrown on the community through dental disease has hardly been recognized until recently, for dental treatment has been provided only to a slight extent for those unable to secure dental treatment for themselves. The indirect results of dental diseases, for the treatment of which the State has provided, have not been recognized until recent years (except in dental circles) to have had a dental origin.

The financial loss to the community resulting from dental diseases is now recognized to amount to fabulous sums. The amount paid by the wealthy for dental treatment, even though it may amount to two or three million pounds annually, is small compared with the loss entailed on those who are unable to pay for dental services. Lack of dental treatment gives rise to vastly more suffering than the actual treatment entails. It is beginning to be recognized that the mouth is not only the chief entrance portal of disease, but also that, in order to restore health, attention must primarily be directed to the eradication of the diseased conditions which are so generally present in the mouth. Thus we read that "the National Insurance Act was brought into being for the purpose of providing the industrial classes with, amongst other things, a medical service, at any rate for the ordinary ailments of life. No provision was made in the Act for dental service, but if it came to the question as to which was more needful—a medical or a dental service—we would unhesitatingly affirm the latter to be more urgent."* This, be it noted, is a quotation from a recent leading article in a medical journal, not from a dental journal.

The financial loss to the community is not represented fully by the amount spent or the amount which might be spent on the restoration of the teeth and mouth to a fairly healthy state. It is now known that one of the most fruitful sources of disease is what is misleadingly called "oral sepsis." Moreover, there are quite a large number of common diseases

* The *Medical Magazine*, April, 1914.

which are concomitant with dental disease in their origin. And, further, several diseases are seriously aggravated in their course on account of diseased states of the mouth.

It is recognized that the State must do something. As regards dental diseases it may pursue one of two courses. It may provide dental clinics all over the country for the treatment of the diseases of the teeth of children, but if it did so there is no reason why it should not likewise provide for the dental treatment of adults; and for from fifty to a hundred million pounds per annum this method of procedure could no doubt be carried out without serious loss to the community as a whole, for the benefit resulting from such treatment might, *if it were continuous*, more than outbalance the money expended. Nevertheless, such a course may not be at all justifiable. It may be that another method exists which is capable of bringing about far more excellent results, and that practically without the expenditure of any money at all. Prevention is infinitely better than treatment, and the failure to prevent the diseases of the teeth simply means getting money from the public or from individuals and placing it in the pockets of doctors, dentists, and thousands of others whom the State does not consider fit to be called dentists although they may be practising the art. Now the State already recognizes its duty to *prevent* disease. Thus we read *inter alia* that the duties of the Medical Officer of Health are as follows: "(1) He shall inform himself, as far as practicable, respecting all influences affecting or threatening to affect injuriously the public health within the district. (2) He shall inquire into and ascertain by such means as are at his disposal the causes, origin, and distribution of diseases within the district, and ascertain to what extent the same have depended on conditions capable of removal or mitigation."*

The State dictates, therefore, that it is the duty of Medical Officers of Health to ascertain the causes of the diseases of the teeth, and to indicate how they may be mitigated or done away with. When it was believed and authoritatively taught that dental diseases were of a hereditary nature, obviously little action could be expected; when, moreover, the diseases of the teeth were generally regarded as of trivial consequence, time and energy spent upon ascertaining their causes could not reasonably have been insisted upon. Now, however, it is authoritatively agreed that dental diseases are preventable, and, moreover, that they are serious in themselves, and still more serious in that they lead so frequently to other diseases. Consequently the attitude which was taken up towards those diseases in the past is now no longer permissible, and it is the duty of the State to exercise such pressure as may be required on those whose duty it is to ascertain the causes, and in how far the conditions which have brought the diseases of the teeth into existence are remediable.

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* "Principal Laws affecting the Medical Profession," the *Medical Directory*, 1913.

For at least the last ten years we have known in a general way how the diseases of the teeth are caused, and how they may be prevented. Authoritative statements as to this may be found in the recent textbooks on dental surgery,* and in the last three annual reports of the Chief Medical Officer of the Board of Education they are tersely summarized. Sir George Newman says: "It cannot be too clearly emphasized that by far the most important factor in the production of dental caries in children is unsuitability in the character of the diet provided from infancy onwards. The immediate cause of the disease is the accumulation about the teeth, particularly in the interstices of the teeth and in the interdental spaces, of fermentable carbohydrate material."

In other words, dental caries results from errors in diet. There has been in the past no recognition of the fundamental principle of dietetics which claims that food should be of such a nature or the diet so arranged that the mouth will be left physiologically clean after the meal is eaten. How such physiological cleanliness may be attained in a simple and efficient way has been worked out some years ago, and—as I have repeatedly indicated and tried to bring forward prominently in my recent book on "Dental Diseases in Relation to Public Health"—when the physiology of oral hygiene is properly taught, dental caries and consequent and concomitant diseases will soon practically cease to exist in all families which are brought up with reasonable care and intelligence. Similarly, in Dr. James Wheatley's Annual Report for 1912 as County Medical Officer of Health for Shropshire, we find the following sentence italicized :

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* Colyer's "Dental Surgery and Pathology;" "The Science and Practice of Dental Surgery," edited by N. G. Bennett.

"Intelligent parents with the requisite knowledge can with a fair amount of certainty bring up their children so that they will have good teeth free from decay."

In the same report Dr. Wheatley says : "The need for a campaign to prevent the conditions above described is most urgent. Each year of delay means another 1,200 children in the county who will have, at the age of five, ten or more decayed teeth, and about 1,800 children who will have five to ten decayed teeth. It is quite impossible by treatment afterwards to remedy this most disastrous start in life." Think what this means. There is no good reason to believe that the teeth of the children in Shropshire are worse than the teeth of children in the other counties of Great Britain; consequently, we calculate that annually something like half a million children commence school life crippled for life by disease in that part of the body which is *par excellence* the entrance portal of disease, and it is quite impossible by treatment to remedy this completely in after-life, even by the expenditure of millions and millions of pounds. I have referred to the important work which Dr.

Wheatley has done. But what have the other Medical Officers of Health been doing ? With a few exceptions we may say with regard to this subject that they have done absolutely nothing. Surely, since the prevention of dental diseases depends upon the diffusion of knowledge with regard to the physiology of oral hygiene, every Medical Officer of Health ought to urge upon physiologists the necessity for them to study this subject and to teach it to medical students, for as it has been through lack of teaching of this subject that dental diseases have assumed the prodigious proportions to which they have attained, so it should be through the diffusion of knowledge from medical men that dental and concomitant diseases will be more or less completely eradicated.

Considering the fact that dental diseases are more prevalent in all districts than any other disease, it is obvious that every report of every Medical Officer of Health ought, if their duty as already prescribed by the State is appreciated, to contain a statement with regard to the diseases of the teeth, summarizing as fully as may be expedient the ætiology of these diseases in so far as it has been worked out and authoritatively recognized; or, if the ætiology of dental diseases as currently taught by those in authoritative positions be not considered correct or sufficient, that a reasoned statement should be made for the setting forth of opinions which are not authoritatively recognized. Another way in which the State might, could, and should bring pressure to bear in such a way as to decrease the amount of dental disease is by insisting on the introduction into the examination for a diploma of public health of questions dealing with the physiology of oral hygiene. It is now so fully appreciated that oral mal-hygiene is a far more common source of disease than insanitary slaughter-houses or faulty drains, that evading the subject of oral hygiene seems to be an absolutely unpardonable neglect of duty. And thus it is obvious that oral hygiene ought to be regarded as a vital part of the curriculum for a public health diploma, or for a diploma in State medicine. I do not intend to refer to any action which the State might take through the medium of the School Medical Officer; however, if we may judge from the reports of the Chief Medical Officer of the Board of Education, and from the reports of School Medical Officers, it is obvious that the prevention of dental disease is within their sphere, if not for the child before entering school, at least for children who are in attendance there. For several reasons it it highly desirable that through the influence of the School Medical Officer the early environment of the child should be ameliorated. Again, as dental diseases are preventable, and since they are recognized as being important factors in the causation of many other and more serious diseases, it would seem desirable that the State should require that all medical students should receive some instruction in the elements of oral hygiene, for lack of knowledge of this subject has in the past caused more disease and suffering than lack of knowledge of the physiology of any other organ in the body could possibly have caused.

I do not know whether school dental clinics should be regarded as part of the early environment of children which it might be supposed was part of the duty of the State to establish. One thing is certain, however, and the ratepayers will in time insist upon it —that whatever measures may be taken by the State, the most efficient and the least expensive measures shall be primarily undertaken.* Those who have gone into the subject at all thoroughly recognize this, and what is quoted from Sir George Newman on p. 2 should be most seriously pondered over by everyone who takes any real interest in the subject.

It may be urged that the school dental clinic is relatively inexpensive, considering the amount of good which it might do, but recognizing that even expensive treatment among the wealthy has done absolutely nothing in the past to decrease the amount of dental and consequent diseases from generation to generation, it may be questioned whether expenditure for school clinics is justified, more especially since through other channels the State could without expense decrease enormously the unparalleled prevalence of dental maladies, and so aid in the greatest triumph over disease that the history of preventive medicine will probably ever record.

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* School dentistry appears to have been rather a failure in Germany. See Geo. Thomson, L.D.S., Eng., and Dr. Van de Broeck, of Holland, *Journal of Dental Science*, May, 1918.

CHAPTER V

ORAL HYGIENE AND PHYSIOLOGICAL SECRETIONS

It is doubtful if anything has compromised child welfare more than the miasma arising from unhealthy, ill-ventilated, and stagnant founts of knowledge.

MUCUS.

ORAL hygiene has, in recent years, been attracting considerable attention in the medical profession, and many leaders of thought now regard the subject as one of extreme importance. Sir William Osler says there is not one single thing more important to the public in the whole range of hygiene. Nevertheless, although oral mal-hygiene is in itself loathsome to contemplate, and although it is recognized as the precursor and cause, directly and indirectly, of quite a multitude of diseases varying in gravity from dental caries to cancer of the tongue, little or no attention is given by physiologists to the subject; indeed, it is never even mentioned in physiological textbooks. They hardly seem even yet to realize that oral hygiene is a physiological process, and that all the glands opening into the mouth, together with their secretions, are specially adapted for the maintenance of oral hygiene, and that these secretions are scarcely, if at all, of importance for any other function. From the point of view of the oral hygienist the supposed function of the mucus for lubricating the bolus of food so as to facilitate its passage down the œsophagus is almost whimsical, for inasmuch as the function of mastication is to comminute the food, and reduce anything in the nature of a bolus to a liquid or semi-liquid state before it passes to the back of the dorsum of the tongue, there is no bolus to lubricate. The mucus and saliva are thoroughly incorporated with the food, and consequently the semi-liquid food does not require lubrication. Just as the function of the mucus in the bronchial tubes is to keep these tubes clean, so the essential function of the oral mucus is for the hygiene of the mouth. Mucus is a liquid, tenacious and ropy in its nature, which under certain circumstances clings to hard substances. Chemically, perhaps, its best-known characteristic is that it forms a flocculent precipitate when treated with acids. These properties of mucus are well known. The following quotation from the work of Professor W. E. Gies and his collaborator Dr. Lothrop—great authorities on mucus—will indicate some further characteristics: " Mucin occurs in saliva, and apparently also on dental surfaces, primarily as acid salts in concentrated colloidal solution. When viscid mucinous coatings are treated with basic material, such as carbonate of an alkali or an earthy element, the mucin mass becomes superficially more smeary and slippery by reason of the production of more soluble mucin salts at the surface. Complete mechanical removal of a mucin plaque from a tooth is facilitated by the addition of a basic material that renders the mucin superficially more viscous, but the slippery surface thus produced may make the application of considerable friction necessary for the detachment of the plaque. On the other hand, when a viscid mucinous deposit is treated with acid material, the mucin mass is completely disintegrated by a curdling or agglutinative process, the particles are devoid of adhesiveness to smooth surfaces, stickiness disappears because of the precipitation of caseous mucin itself, and the entire disorganized mass may be readily flushed away."

A consideration of these properties of the mucus leads us to the conclusion that it is quite ingeniously suited for keeping the mouth free from the undue lodgment of food particles, when the foods are not converted by artificial means into some bland pap-like form which stultifies efficient mastication and negatives "considerable friction." It matters but little whether the chemical reaction of the food is neutral or alkaline, for during the mastication of food the saliva always becomes alkaline if in its resting state it is acid, and the slippery state of the mucous coating on the teeth (and no doubt gums) is assured, while the ropiness of the mucus is left unimpaired. On the other hand, if the food is more acid than can be neutralized by the copious flow of alkaline saliva which it stimulates, the mucus itself is disintegrated and becomes easily removed by the saliva and mucus after the acid has been swallowed. Thus, then, the mucus has not only the power of facilitating the removal of food particles and shreds which have been disintegrated by mastication, but it has also, under certain dietetic conditions, the property of being disintegrated and carrying its own disintegrated self away.

Under unsatisfactory dietetic conditions—that is, when the food is so soft as not to stimulate mastication—the mucous coating on the teeth may remain too long, stagnate, and become infiltrated with the salts of the saliva—that is to say, tartar may be formed ; or, if the food is of a carbohydrate nature and of a sticky character, it may be rapidly converted into lactic acid by the bacteria of the mouth, decalcification of the enamel may take place, and dental caries may be initiated. Should, however, the mucus not be saturated with carbohydrates of an impermeable and easily fermentable nature, the bacteria of the mouth slowly disintegrate the mucous coatings on the teeth and facilitate its removal on those surfaces of the teeth where it has not been removed by considerable friction. It is quite possible, too, that the ptyalin in the saliva may digest the carbohydrate radical in the mucus, just as trypsin does. Why otherwise should we have a saliva rich in ptyalin poured out when *sugar* is taken in the mouth ?

Thus, then, we see that mucus is ingeniously devised for oral hygiene, and it is not devised for the lubrication of the bolus of food to facilitate its transmission to the stomach, nor is it devised, as has been suggested, to keep the numerous boluses of food in the stomach from the action of the hydrochloric acid, so that the ptyalin may have a chance of converting the starch in the boluses. Indeed, it seems much more probable that the thorough incorporation of food with mucus facilitates the penetration of the hydrochloric acid throughout the whole of the contents of the stomach after a meal, and possibly this is one of the reasons why a meal of such a physical consistency as demands mastication is more quickly and satisfactorily digested than a meal of a similar nature which has been reduced to a pap-like form before it is taken into the mouth.

SALIVA.

It seems to me more than probable that physiologists will, in the near future, require to reconsider their teachings with regard to the functions of the saliva. Hitherto they have looked upon it as the first of the digestive juices, and the salivary glands have been regarded as the first of the digestive glands.

In recent years, however, another school of physiologists has come into being which studies physiological problems because of their importance with regard to human welfare, and it has come to the conclusion that to all intents and purposes the saliva is not a digestive juice, but that it is practically wholly for the purposes of oral hygiene. The older physiologists have based their ideas on the fact that ptyalin has the power of converting cooked starch into anchro-dextrine and maltose. But many questions arise which would appear to throw considerable doubt upon regarding this as the chief function of saliva. That the digestion of uncooked starch is practically negligible is admitted by them ; indeed, we are told that ptyalin does not digest uncooked starch (Halliburton, F. A. Bainbridge, and J. Ackworth Menzies). If this be so we may ask why ptyalin exists in the saliva of animals at all. Is it to be conceded that the saliva is not a digestive juice in animals ? Again, it has never been contended that ptyalin digests sugar, but sugar stimulates a relatively violent flow of saliva rich in ptyalin. Why, too, should ptyalin exist in the saliva from birth, as we are told by some physiologists ? Oral hygiene is certainly necessary with a milk diet, but are we to believe that ptyalin is there to digest starch which normally is not present ?

Again, why is starch, immediately it has been masticated and mixed with the saliva, transferred at once to the stomach, where the conditions are so frequently such that the digestion of starch by the ptyalin is immediately arrested, or if it is not immediately arrested, it soon becomes so ?

Physiologists have, of course, long recognised this supposed delinquency of Nature, and attempts have been made to explain how ptyalin may have some reasonable time to digest starch before the contents of the stomach become sufficiently acid to arrest the action of the ptyalin. Thus, for example, Messrs. Bainbridge and Menzies say "the food, after a meal is taken, forms a compact mass in the stomach, and the hydrochloric acid of the gastric juice penetrates comparatively slowly into this mass." They evidently think not only that the food passes down the œsophagus in bolus form, but that the various boluses become one glorified bolus in the stomach! It is significant, too, that these physiologists never seem to refer to the fact that the contents of the stomach may be acid from the very beginning of a meal. A meal may commence with acid *hors d'œuvre*, the bit of fish which may follow may be served with lemon-juice, meat may be eaten with salad well seasoned with vinegar, and stewed or raw fruit or both may complete the meal with a still further supply of acid, while acid alcoholic beverages, which are sometimes supposed to stimulate digestion, may, and very frequently do, accompany the meal at various stages. Nevertheless, I do not know that we are told that acids taken in these ways interfere with the digestion of starch except among dyspeptics. Indeed, Professor Pawlow, speaking of the reaction of the food, says: "It is apparent that acidity enjoys a special preference in the human taste. . . . These facts are all physiologically comprehensible when we know that an acid reaction is not only necessary for an efficient action of the peptic ferment, but is at the same time the strongest excitant of the pancreatic gland."

Another point on which there seems to be confusion is with regard to the medium most suitable for the digestion of starch. According to Messrs. Bainbridge and Menzies, "the digestive action of ptyalin on starch is most energetic in a neutral medium." According to Foster, "the action of saliva on starch is favoured by a slightly alkaline medium." It is curious how this is always referred to as if the slight difference in the reaction of the saliva were really of considerable importance in digestion. I have frequently tested the reaction of saliva between meals, but certainly am unable to draw the inference that the digestion of starch is at all influenced in any practical way by the reaction of saliva. On the other hand, the fact that the saliva always becomes very distinctly alkaline when food is eaten and for some considerable time after it is swallowed seems to the older physiologists unworthy of being mentioned. To the amateur physiologist, who thinks that oral hygiene should be at least as common in man as it is in animals, all these apparently confusing and inexplicable facts have a simple explanation. The marked alkalinity of the saliva when food is taken has a significance in that it is important that it should have that reaction while the mucus is specially required for removing food particles from the mouth.

If the saliva were acid the mucus could not function in this way. Moreover, the acids which so commonly accompany foods might decalcify the teeth. On the other hand, the reaction of the saliva between meals is of practically no importance at all, because the conversion of starch in the mouth into soluble starch proceeds to all intents and purposes sufficiently satisfactorily whether the saliva be neutral, or faintly acid, or faintly alkaline to litmus. It has, indeed, been the subject of much contention whether acidity or alkalinity of the saliva was the more unfavourable to the inception of dental caries. Here let me say, although some physiologists affirm that ptyalin does not act on uncooked starch, others (for example, Michael Foster) say that raw unboiled starch undergoes the same change as boiled starch, "though more slowly."

In a previous article I have *suggested* a use for the ptyalin when sugar is taken into the mouth, and to those who appreciate why sugar is liable to cause dental caries, the reason for a copious flow of saliva when sugar is eaten is obvious. Similarly, the desirability of a copious flow of alkaline saliva when acids are taken into the mouth is equally obvious if we value the preservation of the teeth; but why it should be thought desirable for digestion when acid is "necessary for the efficient action of the peptic ferment, and at the same time the strongest excitant of the pancreatic gland," we fail to see.

While we are regaled with the importance of ptyalin for the digestion of starch, little is told us of the functions of the salts in the saliva, but they, too, are obviously to some extent at least of importance from the point of view of oral hygiene and the preservation of the teeth. Dr. Joseph Head made the important discovery that when the superficial layer of enamel of the teeth has been slightly softened by acid this enamel can be rehardened by immersion in saliva, and thus the salts in the saliva have an important value from the dental point of view.

The saliva contains something more—amœboid phagocytic cells—the so-called salivary corpuscles. They may be regarded as scavengers of the mouth, and, as far as we can surmise, their function is simply oral hygiene. We are told that they are probably derived from the tonsils (Halliburton), and although we might expect that lymphoid cells derived from the tonsils would pass down the throat rather than come forward and mix with the saliva, I at least have not seen reference to any experiment or observations upon which this idea is founded. The late Professor G. V. Black made a careful examination of the lymphatics surrounding the necks of the teeth, and refers to a portion of the connective tissue in the immediate conjunction with the tooth, which is not covered by the epithelium, and says: "It seems to be through this space that the cells—the so-called salivary corpuscles found under the free border of the gingivus—pass. These may be found at any time under the healthy gingivus, and their numbers are augmented with every irritation of the membrane." It has always appeared to me that the only satisfactory method of controlling the bacteria in the sulcus between the gingival margin and the tooth is by means of these so-called salivary corpuscles derived from this lymphatic tissue (the glands of Serres). If we admit that the salivary corpuscles are derived from this source, we observe at once their importance in oral hygiene, and, in passing, it may be said, the value of masticating food of such a nature as will cause an irritation, or at least stimulation, of the periodontal membrane, and thus assure a sufficient supply of these scavengers, and thereby prevent the onset of pyorrhœa.

All things considered, it appears that the function of the saliva is, *par excellence*, oral hygiene, and no matter whether the food passes into the mouth and down the œsophagus in the ordinary way, or whether the food passes up from the stomach and out of the mouth, it may in general be said that the saliva is secreted in quality and quantity proportionate to the needs of the food, to expel the food as completely as possible from the mouth. I need hardly mention that although a copious flow of saliva is induced by vomiting, even physiologists of the old school could scarcely claim that under these circumstances the saliva was to be regarded as the first of the digestive juices.

I have put forward the preceding observations to induce physiologists to take up this subject immediately, and to give an authoritative lead. For without this the rank and file of the profession cannot be expected to teach the public the new ideas consistently. But few have any ideas, or at least any clear ideas, about physiological oral hygiene. Those who have may not care even to admit, except in friendly conversation, their belief in the truth of the new views; or not realizing the harmfulness of delay, are willing to wait for official confirmation. (They do not accept the dental text-books as authoritative. They are encouraged to do this by physiologists talking about the cause of dental caries with the most amusing ignorance of the facts of dental pathology, which fortunately years of scientific research have established beyond all doubt.) It would be too much to expect more than quite sporadically to hear of some influential physician openly saying, "I feel convinced that the view . . . that the function of the saliva is to clean the mouth, and not to digest starch, is the correct one." *

Still less could we expect to find such a one letting a statement of this kind be published. It is more than conceivable that the maintenance of an unorthodox view by a medical man is not likely in a general way to be to his advantage. If, without authoritative position, our facts and arguments have converted all kinds of medical men when they have been induced to look into the subject, surely it is the force of truth that has worked for us, for their early training is against us, and those to whom they look for guidance ignore or are ignorant of the facts.

If physiologists would look into the subject and proclaim the truth, as dentists and those medical men who have studied it have done, they would confer an inestimable boon on the community, and we might even yet be able to look on some of them as benefactors of humanity, instead of as at present regarding them as the greatest culprits with regard to what has been called by one of them "that curse of modern days"—dental caries.

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* Eric Pritchard, M.D., F.R.C.P., *Proceedings of the Royal Drawing Society of Medicine*, April-May, 1919.

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